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Steve Joseph. Bocska
University of Windsor

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URBAN GROWTH MODELS: AN ANALYSIS OF SOUTHEASTERN MICHIGAN AND THE DETROIT AREA

by

Steve Bocska

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ABSTRACT

Population and workforce data were collected for the Detroit area and two of its peripheral cities, Southfield and Troy, over a 40-year period. These data, combined with land use maps, were used to compare the history of the Detroit area to two contemporary models of urban growth, namely those of Hartshorn and Muller (1989) and Erickson (1983). The methods of analysis involved tabulation comparisons, Correlation Analyses and visual comparison of land use maps and histogram charts. The analyses determined that while several similarities existed between the Detroit scenario and the two urban models, there were too many differences to consider either one a 'universal' model of urban growth and development. Additional research concentrated on the changing urban morphologies of the suburban centres. In the "Suggestions for Further Research" section, an alternative non-linear model of urban growth is proposed. This model incorporates several urban variables which are thought to affect the type and direction of growth, such as transportation, communications, economic specialization and the structure of the local economy.

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CHAPTER I

INTRODUCTION

Prior to the end of the Industrial Revolution, the desire among companies to centralize corporate control in the core of metropolitan areas greatly influenced urban form (Burgess, 1925; Haig, 1926). The result of such 'control' was an urban arrangement described as 'monocentric', meaning that the metropolis possessed only one significant business district. Recently it appears, however, that certain control functions and activities have increasingly chosen to locate in the peripheries of urban areas (Muller, 1976; Ley, 1985; Hartshorn and Muller, 1989; and Matthew, 1993). Many explanations for this phenomenon have been offered, including substantial improvements to transportation networks (Hall, 1990), telecommunication sophistication (Moss, 1987; Hepworth, 1987) and a desire to locate near a suitable labour force (Huang, 1989).

Although the decentralizing phenomenon is not a new concept by any means, there have been surprisingly few recent contributions to this field of research. Modeling of suburban growth patterns has not been a priority of urban researchers, despite continued peripheral growth which remains a very real trend in the modern urban centre. The recent growth of suburban centres of activity immediately surrounding metropolitan Detroit suggests the emergence of multiple centres--a pattern described as multi-nucleation, or 'polycentricity'. The situation in Detroit represents an opportunity to document the degree to which certain patterns and forces have appeared in the area as set out in the recent models of urban decentralization proposed by Hartshorn and Muller (1989) and Erickson (1983).

In order to conduct this study, it was necessary to collect population and occupation data for both downtown Detroit and two peripheral urban centres. The source for these data was U.S. Census information dating back to 1950. Contingency Table analyses and correlation tables

were used to determine whether or not significant differences could be found among the three centres during the last 40 years. Land use maps for 1970 and 1992 were also prepared for Southfield and Troy in order to provide insight into the changes in the urban morphologies of the two centres. As a result of findings and conclusions emerging from this study, an alternative model of urban growth is presented in the "Directions for Further Research" Chapter.

Chapter 2 of this paper is a review of relevant literature on urban growth models. Particular attention is paid to contemporary research on the effects of communication technologies and economic factors on urban growth patterns. Chapter 3 introduces the 'A priori' models which attempt to structure the process used by locational decision-makers who have either chosen to decentralize or remain in the city centre. This is followed by the introduction of the hypotheses intended for testing. Chapter 4 sets out the methodology used in this study. Chapter 5 outlines the observations based on the analysis and Chapter 6 suggests possible routes of further research, including the introduction of a decision-tree flow chart model of urban growth.

Study Area

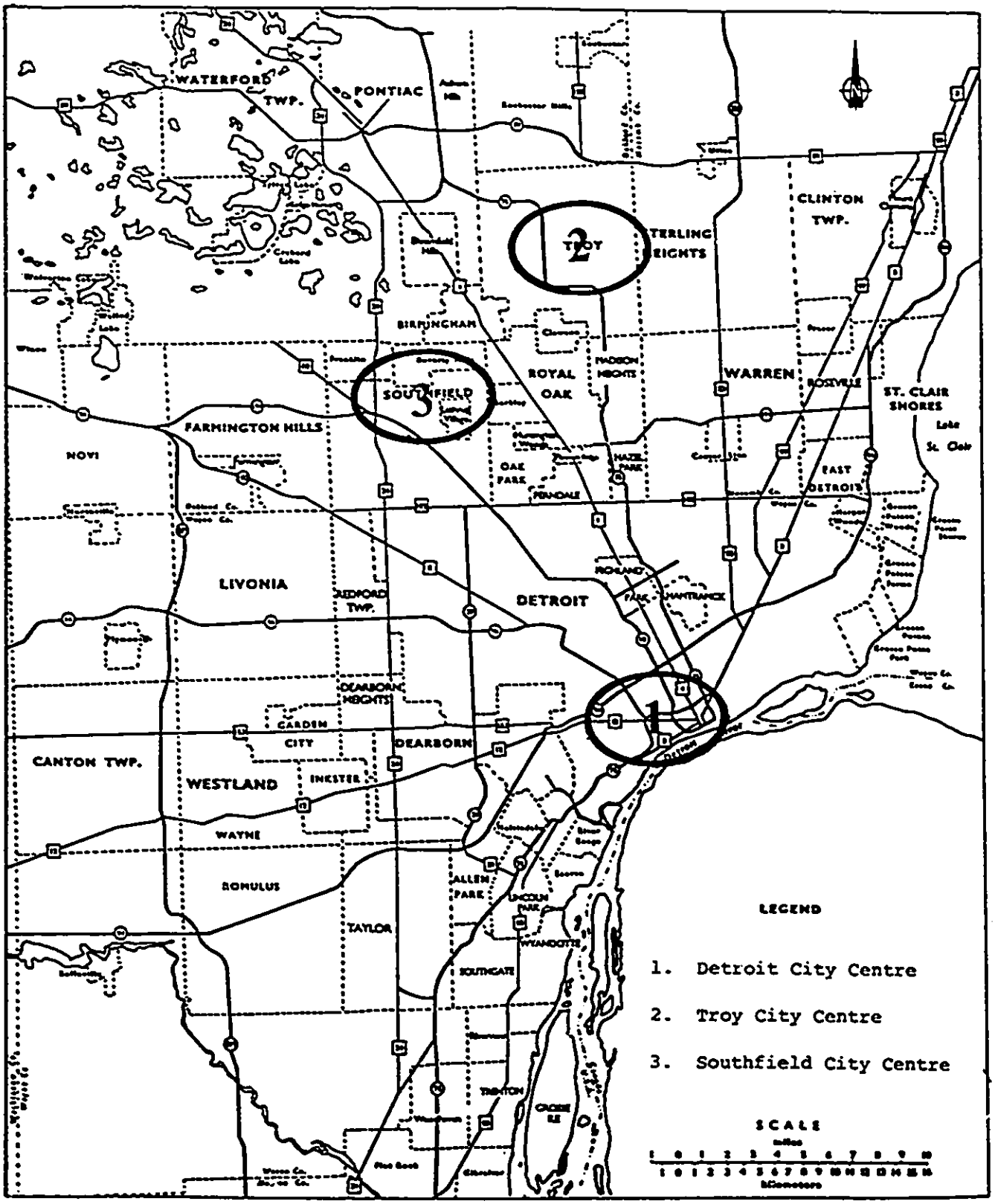
Detroit, located in the southeast corner of Michigan (see Figure 1), has experienced substantial peripheral growth in the past 40 years. Urban development outside the inner city has resulted in major employment centres in Detroit's suburban municipalities. Office complexes, such as 'The Galleria' and 'The Prudential Centre' in Southfield and 'K-Mart International Headquarters' and the 'Big Beaver West Complex' in Troy are all recent developments which visibly illustrate the trend. Meanwhile, downtown Detroit City has been experiencing very little growth.

Many years ago, Colby (1933) suggested that certain areas of cities tend to exhibit 'centrifugal' and 'centripetal' forces upon specific urban activities. He stated that centrifugal forces are made up of a combination of uprooting impulses in the central zone and attractive qualities of the periphery. Centripetal forces, on the other hand, focus on the central zone and

make that zone the centre of gravity for the entire urbanized area. Contrasting the downtown core of Detroit with its periphery paints a picture of substantial social, economic and infrastructural inner city decay. Given the degree of recent suburban growth, this would suggest that 'centrifugal' or 'suburbanization' forces have been at work for some time (see also Perry, 1987; Hill and Feagin, 1987).

The situation in Detroit, with its declining population and no obvious prospect for immediate commercial or industrial rejuvenation, offers an opportunity to study the pure process of urban decentralization in an area of limited metropolitan growth. Similar studies, such as those conducted on Atlanta (Hartshorn and Muller, 1989) and Toronto (Gad, 1975; Huang, 1989; Matthew, 1993) have yielded insight on the causes of this trend, but the insights have always been qualified by other possible influences resulting from the economic growth of the central city. The history of the Detroit area, on the other hand, has been marked by outbreaks of social unrest, extended periods of industrial dependency and what might be delicately referred to as "political stagnation". It is hoped that the addition of a study on the decentralization of a city like Detroit will help to fill some of the gaps in the knowledge of urban decentralization.

Figure 1. Study Area: Southeastern Michigan and the Detroit Area



CHAPTER 2

LITERATURE REVIEW

The decentralization of activity from metropolitan cores has been occurring in North America for at least the past 45 years. Colby's (1933) assertions regarding centrifugal and centripetal forces were merely precursors to the more severe and distinctive examples of decentralization occurring today. Perhaps the first to formally identify the contemporary trend were Harris and Ullman (1945). Their contribution was a model of urban growth and development which identified 'nuclei' of urbanization outside of the city. They envisioned a multiple-nuclei arrangement in the central city, resembling a network of nodes. Revisions to this "multiple nuclei" model were subsequently provided by Muller (1976) and Erickson (1983). Hartshorn and Muller (1989) have offered the most recent interpretation of the process of "suburban downtown" formation. All three of these models represent the foundation of the research of this paper and will later be examined in detail.

A number of studies have been performed on the factors associated with changes in urban growth patterns. The most studied factors in terms of current research concern transportation and communication, each of which are examined here.

Transportation

In terms of the entire history of urbanization, decentralization, or peripheral relocation, is a relatively new phenomenon in urban research. The Industrial Revolution of the nineteenth century increased the need for management functions such as decision-making operations and supporting clerical work. In an era of poorly developed transportation facilities, there was a *centralization* of manufacturing and management in the city to take advantage of 'agglomeration economies'. An 'agglomeration economy' is an economic advantage gained by industry as a result of the ability to locate near a concentration of advantageous production variables, such as an available workforce, well-developed transportation facilities and communication networks (Weber, 1963; Scott, 1986).

Berry and Cohen (1973) noted that spatial structures of urban centres were all designed to achieve 'urbanization economies'. In their research, they identified the clear economic advantage of the larger city due to the presence of these forces. One such economy is that of transportation costs. Larger cities are capable of offering lower transport costs for regional and national destinations because of their advanced transportation networks and investment in transportation technologies, each made possible by economies of scale. Those seeking cost-reducing alternatives for transportation facilities, therefore, would be likely to locate in the larger city. Other attractive economies offered by the larger city, according to Berry and Cohen, are those of an extensive, diverse and dynamic labour force and the large scale and range of support services. Despite attractive forces, however, their research concluded that many negative externalities had appeared which were diluting or negating the economies found earlier in larger cities. As a result of labour competition, high costs of urban living and high land values the large urban city began to experience a decentralization of activities. Berry and Cohen specifically identified Detroit, Michigan as having lost 1.8 percent of central city manufacturing jobs between 1958 and 1967 while suburban jobs had grown by a disproportionate 47.6 percent.

In fact, Massey (1984) found that as manufacturing production techniques improved through the mid-1900's, so did the per capita productivity of the labour force. According to Massey, this productivity increase reduced the corporate dependency upon a geographically defined labour pool, thereby eliminating some of the 'agglomeration' benefits of centralization. During the middle of this century, mass use of cars and trucks and the building of roads and highways introduced an increasing degree of flexibility in transportation services. The economic recession of the 1970's forced manufacturers to seek and employ cost-reducing activities, such as electronic data transfer and production line automation. These activities, Massey suggested, further reduced spatial constraints and incentives. In addition to reducing locational restraints, twentieth century innovation has also altered the composition of labour in industrially-active countries (Heilbroner, 1962). In 1981, the Organization for Economic Cooperation and

Development found that in their member nations the labour force involved in information processing jobs had reached a level which ranged between 40 and 50 percent of the total national labour forces (OECD, 1981). This shift towards information processing has affected the nature of nearly every industry. In 1987, Brotchie, Hall and Newton developed a system of classification of industrial activity based upon the degree of spatial dispersal and the technological status of the industry. In addition, they suggested a third factor, called 'formality', as an additional level of classification. This concept of 'formality' indicates the extent of vertical interaction between the operational levels of control in the industry. They concluded that control functions, such as corporate decision making, would tend to be classified as being limited in spatial options, and would be spatially focused. Conversely, those operations which are information-based are able to exhibit much greater spatial dispersal. Cohen (1981) considered the implication of this in reference to an international labour market. He determined that this dispersal of information industries along with a sophisticated global telecommunications network allows global network nodes to arise in some cities, particularly in those which specialize in international finance and/or services required for commodity production.

Communications

Perhaps the most telling statement of the importance of communication networks in today's society was offered by Kerr (1963). He suggested that the knowledge industry emerging in this half of the century is serving as the focal point for national growth. Kerr likens this to the impact of railroads in the second half of the last century and automobiles in the first half of this century. With the increasing corporate and industrial dependency upon national and international information flows, it is becoming more and more critical to locate near a 'node' in an information network. This trend has introduced the 'information/communication' variable into the process of strategic location selection.

Hymer (1971) indicated that one of the trends which has resulted from communication advances is the tendency of branch plants to locate in specialized production centres; field

offices in regional cities; and corporate headquarters in global cities. Telecommunication improvements have also permitted some service industries, such as insurance companies, to overcome barriers and locate in the peripheries of urban centres, or in some cases even further from well-established urban concentrations, in order to take advantage of lower land costs. Other services, particularly banks, rely a great deal upon trust, which virtually necessitates face-to-face proximity to their clientele (Meier, 1985).

It is not difficult to extend this concept internationally into the global workforce. Transnational corporations rely so heavily upon the transmission of large blocks of data that it becomes economically feasible for the corporation to use leased high-capacity, electronic communication networks. These corporations will tend to locate along the branches of these networks (Langdale, 1989), simulating the effect that highways, seaways and railways had on urban growth patterns decades ago. Taking this another step further, Harvey (1989, p.22) suggested that *any* urban centre could become a centre of "...coordination, decision-making, and control within a hierarchically organized geographic structure" with proper development of a communications infrastructure. Wheeler and Mitchelson (1989) identified five dominant centres of information genesis in the United States. These were New York, Los Angeles, Chicago, Atlanta and Dallas. All five of these centres have distinctly different urban arrangements, historical backgrounds and relationships with their peripheries, yet have developed into virtually the same functional unit from the standpoint of an information network.

There is, however, one major difference between attractive forces exerted by sites with physical transportation advantages and those having information communication advantages. Communication satellites are able to avoid some physical barriers to linkages by 'beaming' information directly into the site of demand (Meier, 1985). There is, as yet, no way to accomplish this with transportation. Before satellites were available, however, even inter-city transmission of information required that it be routed through the peripheries of the cities along transmission lines that were usually government regulated. Geostationary satellites allow private

transmission of information, thus avoiding use of a physical transmission line and government intervention. Meier (1985) views such an accomplishment as a revolutionary 'total annihilation' of the friction of space with regard to information transfer.

The increased corporate and industrial dependence upon data flows has caused a change in the perception of information and data. Today, the acquisition of information is no longer a right, but one which usually carries with it an associated cost. Porat (1977) determined that in industrial-intensive countries information itself had become a commodity. Such a commodity, he argues, is a tangible product, thus requiring a workforce of producers, processors, distributors and infrastructure workers. Funk and Kowalski (1987) suggest that the commodification of information will result in the obsolescence of old industrial centres which cannot adapt to the 'information age'. As well, the reduction of production dependency upon materials will cause a reduced dependence on transport cost-minimizing locations. Industry would, therefore, enjoy a greater flexibility in location. Wigan (1985) further suggests that the gap between the 'information elites' (the 'haves') and those without such resources (the 'have-nots') could widen substantially as the information elite use their resources to produce even more information. Wigan says that those seeking to dominate information control should locate in the central city where information is the most readily available.

Through the use of portable computers, facsimile machines, electronic networking and telephone modems, some potential commuters are able to work at home and 'transmit' their work assignments to the office in lieu of commuting to a specific work location (Jeppsen, 1984). Firms which depend upon 'telecommuting' of their workers would prefer to locate along a well-developed telecommunications network. The long-term implication of these trends would be the greater locational appeal enjoyed by inner-cities over the peripheries until the peripheries are equally well linked to the high speed, high capacity communications 'net' (Funk and Kowalski, 1987). This would result in the return of a modified 'agglomeration benefit' to the core city.

Clearly, telecommunication infrastructures could serve to support, and indeed, encourage the international service economies of countries. Lakshmanan (1989) feels that the social effect of this highly accessible technology would be a strengthening of the function of the home as a "shelter". Home teleshopping, cable information services and on-line media data bases are providing services directly to the home which previously required actual travel time. While the spatial penetration of such free-flowing information and services appears to have no limits, this is not entirely the case. Barriers are constantly acting to inhibit the dispersal of information flows. Some of the most common barriers to the flow of information are language, confidence, culture and physical barriers (Button and Rossera, 1990). Such barriers have been shown to actually increase the demand for physical transportation facilities as well as the *desire* to travel (see Khan, 1976; Parker, 1976; Memmott, 1963).

The information revolution is a reality of our modern society. For the first time in the history of commodity exchange, it is possible to transmit a representation of capital at nearly the speed of light across the surface of the globe. One must maintain perspective, however, in the role of this technology in locational decision-making. Perhaps this was best addressed in the words of Mandeville (1983, p.69) who stated that availability of "...information is a 'necessary', though not sufficient, condition for locational change."

Models of Urban Growth

Models attempting to forecast and classify urban growth patterns have been proposed by researchers for decades. Burgess' (1925) concentric ring theory was the first widely accepted model. Other early models, such as those suggested by Harris and Ullman (1945) and Hoyt (1939) have been well-cited and criticized. The following is a somewhat more contemporary look at the state of recent research in the field of urban growth modeling, a field which still must be concerned with the impact of technological change.

As mentioned earlier, certain technological advances have had great impacts upon urban growth patterns. Harvey (1989) noted that the transportation and communications revolutions of

this century *had* created a profound shift in the perception of space. Many locations are no longer obviously more advantageous than others. In his view, this causes land to assume the role of merely a financial asset and a form of 'fictitious capital'. In addition, the notion of 'space extension' has been offered by both Richardson (1972) and Kellerman (1984). 'Space extension' implies that individuals and firms can enjoy an increased flexibility in location since the information they require as input for daily operation can be transmitted over larger distances. This ultimately eliminates the need to locate close to the source of the input. Such a phenomenon, suggests Gotterman (1977), could conceivably reduce the need for interpersonal contact, resulting in a significant reduction in the comparative advantage of cities over rural sites.

Pressman (1985) suggested that manufacturing is usually the first sector to take advantage of the improved technologies. Lower land rent in the less-urbanized periphery is extremely attractive to manufacturing due to the large inputs of real estate required for production facilities and their associated employee parking areas. Therefore, any technology which acts to 'extend' space has been readily welcomed by manufacturers. The harnessing of space extending technologies has allowed peripheral clustering, exemplified in industrial parks located in the urban fringe. Activity at these peripheral manufacturing sites requires little face-to-face contact between the plant and the controlling regional or head offices. High technology corporations, on the other hand, seek either peripheral locations *or* medium-sized towns which will adapt and specialize to accommodate their technical requirements (Nijkamp and Mouwen, 1987).

Pressman (1985) has indicated the likelihood of a proliferation of non-metropolitan growth as a result of continuing rapid technological change. He feels that high levels of communication between cities will reduce the advantage of the large megalopolis. As a result, concentrations or agglomerations of white collar labour will disappear due to the ability to transmit information directly to the site of consumption. Thus, there would be little need for *any* agglomeration. Birch (1975) predicted that the strengthening of such networks would ultimately weaken the

urban hierarchy resulting in an unstoppable dispersal of people into the suburbs and a loss of interest in the inner city. Hall (1990) however, disagrees that these influences will ultimately result in the demise of the city. He feels that the importance of urban centres in the global hierarchy as well as the human need for social interaction will always act as agglomerating magnets.

van Lierop and Nijkamp (1985) identify three current trends in urban systems today. First, cities such as Mexico, Seoul and Bombay indicate that there is continued growth in large urban agglomerations. Certain conditions must therefore exist which encourage locating in well-established, highly (or 'over') populated, cities. Second, there is obvious urban decline, sprawl and deurbanization in many large western cities such as Boston. These cities experience actual decline in population and employment of the inner-city while growth occurs in their peripheries. And lastly, some 'medium' sized cities in the United States are showing signs of re-urbanization of the inner city. Hall (1990) further suggests that cities and towns will eventually develop different functional personalities resulting in a shift towards operational specialization. These specialized centres would all connect in a global network of control, service and production nodes. Kindleberger (1978) envisioned the emergence of such a 'world financial market' which he attributed to the increased ease of information and commodity flow.

For decades, 'distance gradients' have been an accepted fact of urban morphology. As one traveled further away from the inner city, land values generally declined. Heikkila, et al. (1989), however, examined the CBD distance gradient in Los Angeles through the use of hedonic regression models and found that the gradient which had historically been so firmly in place was breaking down. This research was inspired by earlier findings by Gordon, Richardson and Wong (1985) which first suggested that polycentricity, with each nucleus exhibiting its own 'distance gradient', was becoming a more appropriate model of urban form in metropolitan areas, particularly those in the western United States. The mononuclear model, they claim, has not been a valid model for Los Angeles since the early 1970's. A similar analysis performed by

McDonald and McMillen (1989) determined that the city of Chicago may have actually experienced a positive skew in the distance gradient in its peripheries as early as 1928. More recently, the land value function (indicating the correlation between land value and distance from the CBD) has been steadily decreasing in Chicago, indicating the further relative decline of the core as the most valuable site.

The 'Technopolis' of the early 1980's was discussed by Glickman (1987) and represents perhaps one of the earliest projections of the future of urbanization based on modern trends, principles and technology. A 'Technopolis', essentially represents a specialized centre of commerce and industry. At a population of only about 50 000 over 1000 hectares, the Technopolis would be concerned primarily with research and development and would have an academic zone to supply an appropriate labour force. The implication of a network of specialized cities such as the Technopolis is one of exported control. More and more, the decisions applied within these cities would come from 'controlling centres' elsewhere.

One of the best recent attempts at modeling the pattern of urban decentralization was that of Erickson (1983). His model was based on his study of 14 metropolitan areas in the United States where suburban nucleation and share of the metropolitan areas' employment had been increasing. Virtually all of these expanding suburban areas were located along major intercity highways, most being at, or very near, a freeway interchange. From this study Erickson generated a three-stage model of suburban development.

The first "Spillover and Specialization" stage occurred in the 1920's to 1940's in the U.S.. During this time, suburban employment levels increased as a result of industrial plants spilling over into the suburbs. However, the management functions which controlled the operations remained in the inner city. The early commercial settlers into these suburban locations coalesced into centres of agglomeration and activity, although the resident population remained largely dependent upon the services, commerce and activities offered by the CBD. Discrete hubs of

operational specialization could be distinguished in the metropolitan peripheries due mostly to locational characteristics and land costs providing advantages to firms.

Stage two represents the period of "Dispersal and Diversification" (1940-1960) in the suburbs. A massive migration of the inner-city population to the suburbs coincided with improvements in transportation technologies resulting in a rapid expansion of locational choices for urbanization. North America's cultural orientation towards the automobile, and to a lesser extent the railway, as preferred modes of transportation created the 'commuter' and increased suburban potential. Diversification resulted from the acquired ability of the suburbs to support self-serving functions causing the attraction of nearly every type of operation. This stage also saw the introduction of the suburban shopping mall, thus reducing suburban reliance upon the services of the inner city and making the suburbs more self sufficient.

The third and final stage is "Infilling and Multinucleation" which was occurring between the 1960's and 1983 (the time of the article's publication). Over this 20 year period, the population of the U.S. inner cities remained virtually unchanged while the suburbs experienced a disproportionate growth of 45 percent. During this time, there was a continued demand for suburban land. Erickson suggests that infilling of the land which was passed over by earlier development would likely occur. Use of these 'passed over' areas was facilitated by the popularity of beltway highway construction in the United States.

Like Erickson (1983), Hartshorn and Muller (1989) also considered the tendency of urban centres to form 'outer cities' or 'satellites'. Their conclusions resulted in the formulation of a five-stage model describing the differentiation of urban morphology. The five stages of the model correspond to the following periods of suburban evolution: 1) a 'bedroom community' based on the desire for home-ownership; 2) the 'independence stage' where suburban shopping centres create a commercial focus; 3) a period of 'catalytic growth' during which diversification of functions occurs and multi-use 'suburban downtowns' appear; 4) a 'high-rise/high-technology' stage of increased awareness towards function and aesthetics in the suburban downtowns; and 5)

a (future) 'higher-order' phase of development which will introduce a new awareness of suburban cultural and recreational facilities.

Hartshorn and Muller's significant contribution is the introduction of a set of criteria which must be fulfilled in order for a suburban centre to be considered a true 'suburban downtown', which is the key structuring element in the last three stages. Based on their descriptive research on Atlanta, they decided that to be a 'suburban downtown' a centre must contain:

- at least one regional mall containing a minimum of one million square feet;
- at least five million square feet of office space;
- three or more high-rise office buildings;
- at least one Fortune 1000 firm headquarters;
- at least two major hotels containing more than 400 rooms each; and
- total employment of at least 50,000 persons

Erickson doesn't formally classify a suburban downtown in this way. However, the models of Hartshorn and Muller (1989) and Erickson (1983) nonetheless show several similarities in their identification of significant periods, or stages, during the suburbanization of an urban area. These are outlined in Table 1.

Table 1. Erickson and Hartshorn and Muller Models of Suburbanization

Year	Erickson	Hartshorn and Muller
1920-1940	"Spillover and Specialization" -spillover of employment and population into suburbs	Not formally identified
1940-1960	"Dispersal and Diversification" -massive migration to suburbs -increased dependency on automobile	"Bedroom Community" -desire for home ownership pushed population towards vacant land in suburbs
1960-1970	"Infilling and Muitinucleation" (until 1983) -nearly all metro growth occurs in suburbs -infilling facilitated by highway networks	"Independence" -suburban commercial activity creates a suburban focus -core city loses some control over suburban sites
1970-1980	Covered under "Infilling and Multinucleation"	"Catalytic Growth" -suburban downtowns begin to demonstrate independent regional identities -total employment exceeds central cities
1980-present	Not applicable	"High-Rise/High-Technology" -increased identity introduces aesthetic and functional considerations -parity with central cities

Technological improvements, according to Hartshorn and Muller, have allowed the 'control' functions traditionally found in the inner city to begin to appear in the peripheries. A distinctive element in the Hartshorn and Muller model compared to that of Erickson is the implication of the 'fifth stage' where the suburban centre establishes itself as a centre for the arts, entertainment, sports and culture with some form of "local governance". Supporting research

by Matthew (1993) also found a pattern of development similar to the Hartshorn and Muller model in Toronto, although he suggested some revision of the defining parameters for Canadian 'suburban downtowns' to account for the differences between cultures and characteristics of the two countries.

In 1970, Doxiadis completed a study specifically on the Detroit Area which examined, among other things growth patterns in Southeastern Michigan. Doxiadis formulated a six-phase model identifying the process of change in Detroit between 1850 and 1970. These phases are summarized in Table 2.

Table 2.
Process of Change in Detroit by Phases (Doxiadis, 1970)

Phases	Duration	Characteristics
First Phase	1850-1900	• positive growth in population, commercial functions and physical structure • high income inner city
Second Phase	1900-1910	• population growth exceeds capacity of inner city • physical structure deteriorates • income levels remain high, commercial and other functions continue to grow
Third Phase	1920-1930	• population beyond planned capacity • high income population seeks alternative locations • commercial and other functions grow
Fourth Phase	1930-1950	• traffic congestion becomes a problem • outmigration of high income population continues, total inner city income decreases • outward movement of commercial and other functions
Fifth Phase	1950-1960	• inner city problems reach highest level, then slowly decrease • negative, unsafe physical urban structure • non-white population predominates in inner city • largest outward movement of commercial and other functions
Sixth Phase	1960-1970	• outward pressures decrease in central area • core turns into non-white ghetto • very little revitalization of activity

Doxiadis' (1970) model provided a very valuable glimpse into the understanding of Detroit's historical urban development. He identified the construction of freeways and the improvements of existing highways (intended to relieve inner city pressures) as the critical change during the 1950-60 period which enabled the outward movement of activity from Detroit City. The resulting disintegration of the physical structure of the central city reduced the quality of the environment in the downtown area. Doxiadis (1970) found that the most characteristic phenomenon during the 1950-60 phase was the large outward movement of the middle- and high-income people. He did not, however, identify where these individuals finally relocated.

Doxiadis (1970, p.142) stated that the trends in decentralization during the 1960's suggested that the urban system in the Detroit area would "...continue to develop like an octopus along the main urban corridors". The periphery would continue to expand at the expense of the inner city, causing the increased decline of population, income levels and physical environment in Detroit's core. Commercial functions would follow the middle-income populations that they were geared towards, thus moving them to the outskirts as well. The only remaining central commercial activities would be geared to the lower-income downtown population. Doxiadis related this compounding effect to an urban 'disease' which could infest a system and spread until it was either controlled through corrective measures or until it permeated the entire system. He claimed that unless some 'revolutionary' changes were made to the physical and social structure of inner city Detroit, this scenario would be inevitable.

CHAPTER 3

A PRIORI MODEL

Locational Decision-Making

The process of locational decision making begins with an analysis of both the pertinent characteristics of a location and the operational requirements of the individual. These characteristics are filtered by the 'consideration processes' of the decision maker (see Figure 2). The location which possesses the best combination of characteristics suited to meet the corporate needs becomes the 'optimum site' for location. Throughout the Industrial Revolution the consensus was that location in the central business district, or CBD, represented this 'optimum site' (Weber, 1963). However, recently a large number of offices (which is generally representative of decision-making operations) have been locating in the periphery of metropolitan centres (Hartshorn and Muller, 1989; Matthew, 1993). This suggests that the 'needs' of the decision makers, the characteristics of the cities, or both factors, have changed.

The 'operational requirements' of individuals or corporations are the necessary facilities, services, resources and activities which are desired in a site or within 'accessible' range of it. One such requirement considered to be important by Cohen (1981) and Brotchie, Hall and Newton (1987) is interaction. 'Interaction' implies interpersonal contact, both face-to-face and electronic. The need for a high degree of face-to-face interaction would suggest that a location close to the target interactors would be optimal. However, well-developed telecommunication networks have allowed the spatial dispersal of operations for which the interaction requirements of face-to-face contact are minimal (Glickman, 1987).

Another consideration influencing location decisions of corporations is the accessibility of the location to an adequate and appropriate labour force (Nelson, 1986). For many operations, the lack of a highly accessible labour force would be disastrous. Decisions must be made by

employers to either locate near the employee or to provide facilities for the relocation of future employees (for a dissenting view see Matthew, 1993; Huang, 1989). 'Agglomeration economies' are clusters of similar functions that result in a concentration of amenities for production and operation (Weber, 1963), producing economies that are also one of the factors which are desired by both corporations and individuals. These advantages are sought by smaller, younger companies which seek an 'incubational climate' in the geographic clusters of developed facilities and business services required by the corporation.

The situational characteristics of sites also affects location decisions. Undoubtedly one of the most important considerations is a well-developed, uncongested and well-maintained transportation network (Matthew, 1993; Huang, 1989). In many cases, the locational advantage of a site at the intersection of two major highways in the metropolitan periphery has surpassed even the benefits of a central location in the city's core (Hartshorn and Muller, 1989; Erickson, 1983). The cost of land or rent is also a consideration in location, particularly for companies and employees of businesses which are younger or are financially constrained. The degree to which 'agglomeration economies' have been developed often results in a site where specialization of some activity has occurred, such as Silicon Valley's electronics industry or bedroom communities specializing in the provision of housing like Kanata near Ottawa. Firms locate in such sites in order to 'keep in touch' with the state of the art in their field, while individuals enjoy a higher degree of personal interaction.

The perceived factors characterizing various sites are then evaluated based on 'economic' and 'functional' considerations. Economic factors are 'weighed' with reference to their relative economic value to the corporation. High land costs at a site, for example, may be justified by a superior transportation network which reduces access costs. The 'functional' considerations, on the other hand, are approached from an operational standpoint. For example, the decision to locate at some distance from a desired labour force may be deemed necessary if the required face-to-face interactions between related establishments are high. In such a case, an area of

clustered office development may be better suited to the corporation. Individuals, meanwhile, may desire a location based on availability of shopping, community activities or leisure opportunities. When the two sets of desires coincide it will result in the creation, over time, of a multi-activity centre or 'suburban downtown' which satisfies the aspirations of both firms and individuals and which has a strong degree of attraction for other firms and individuals.

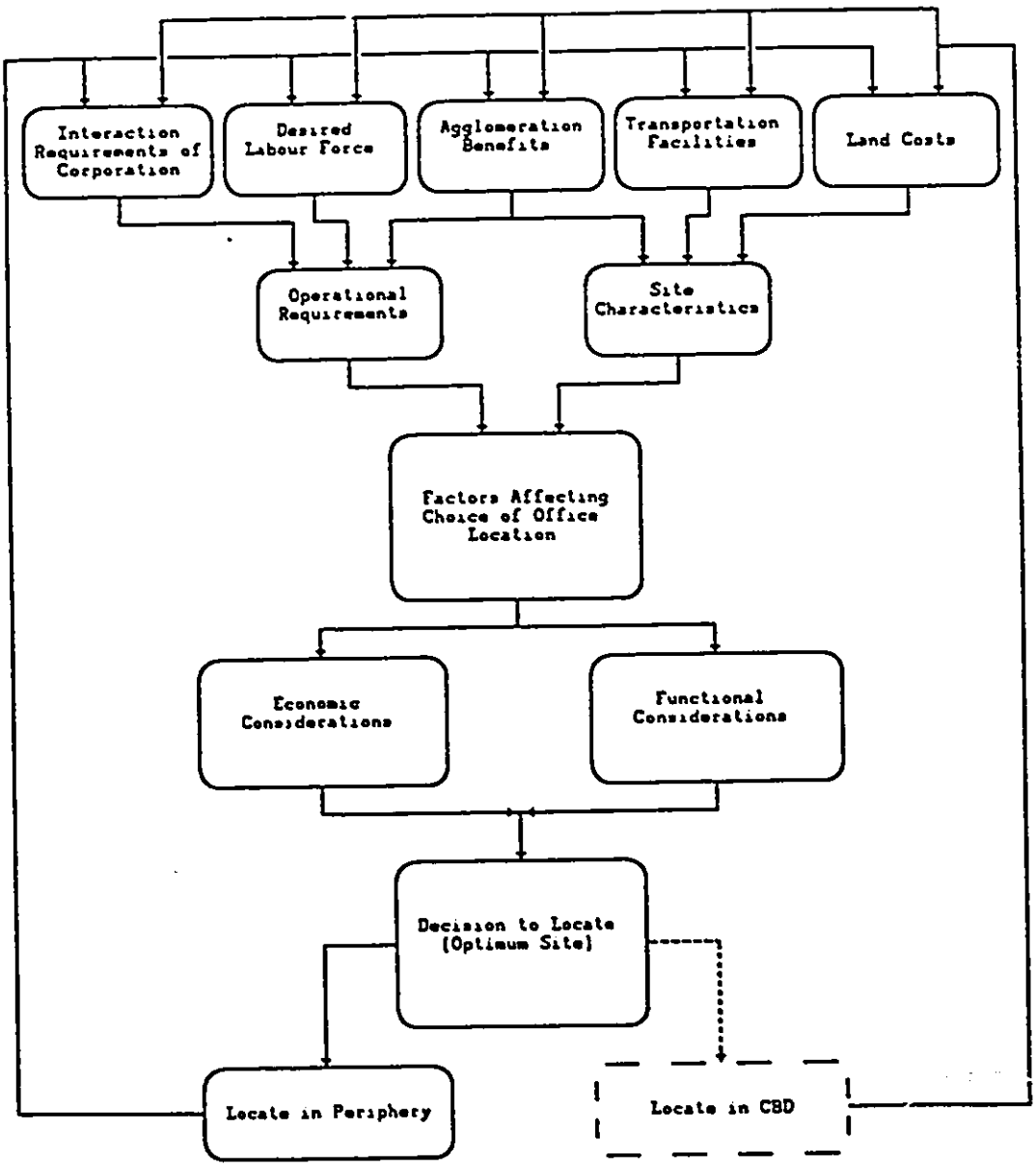
The result of this filtering process is the rational selection of an 'optimal site'. Once (re)location has occurred, a new set of locational factors are established in the mind of the decision maker. These would include any needs which are not entirely met at the new site, or needs which were not considered before the location was decided upon. When these factors become substantial enough to consider relocation, the decision making process begins again.

Hypotheses

As stated earlier, the 'optimal site' for location appears to be found more frequently in the periphery of larger metropolitan areas than in their centres. An 'a priori' model has been formulated to provide a conceptual framework for the decision making process of location selection for companies and population. Under this model, one can see how certain influences could have led to the decentralization of economic activities in North America (see Figure 2). The principles in this model provides the foundation for the **first** hypothesis that there is a decentralization of employment in Southeastern Michigan. The **second** hypothesis is that this decentralization is selective by occupation and varies from place to place and through time. Next, the nature of development and characteristics of these centres of population will be examined. The 'a priori' considerations here will be based upon the work of Hartshorn and Muller (1989) and Erickson (1983). These will be incorporated into the **third** hypothesis, which states that the models of both Hartshorn and Muller (1989) and Erickson (1983) are valid and applicable to Southeastern Michigan. Also, considerable attention will also be given to a temporal-spatial analysis of both Southfield and Troy during the period between 1970 and 1992.

This translates into the **fourth** hypothesis, that suburban centres do not necessarily develop from or towards a monocentric pattern.

Figure 2.
A Priori Model for Location Decision Making



Source: Author, 1992

CHAPTER 4

METHODOLOGY

Data collection

One of the primary concerns of this research was to compare the models of urban growth proposed by Hartshorn and Muller (1989) and Erickson (1983) to the development of the Detroit area. In order to determine whether Detroit conforms to either of these models, it was necessary to examine certain characteristics within Detroit City and its suburbs. Three primary locations represented the focus of this study. The 'inner city' location was Detroit City, while the selected 'suburban' sites were represented by Troy and Southfield. Selection of these two peripheral urban centres occurred during the developmental stage of this study. At this time, it was suspected that Southfield and Troy's dramatic growth over the past several decades, both in office square footage (see Table 3) and population, was an indication that they were likely candidates for the 'suburban downtowns' of the models proposed by Hartshorn and Muller (1989) and Erickson's (1983). Also, the physical distance of these two centres from Detroit indicate correspondence with the models as well. Additional examination of U.S. Census data indicated the recent development of these centres into locations of substantial employment and activity, further suggesting that they might be candidates for classification as 'suburban downtowns'.

The suburbs of the Southeastern Michigan area have been growing at an appreciable rate for the past 30 years. Since the U.S. census bureau has collected both population and occupation data over this period in 10 year intervals, the data did not require any adjustment or estimating procedures to compensate for missing data or inconsistent sampling. The data was collected from 1960 up to the most recent 1990 census. Data from the 1950 census was not available for

Table 3. Office Square Footage in Michigan

Municipality	Pre 1983	1986	1990	% increase 1982-1986	% increase 1986-1990
Detroit	27,553,971	27,885,971	28,854,893	1.2	3.5
Southfield	12,539,270	17,685,645	21,038,329	41.0	19.0
Troy	6,620,896	11,273,127	14,915,702	70.3	32.3
Warren	9,186,418	9,342,997	9,374,197	1.7	0.3
Farmington Hills	1,194,983	4,378,175	6,955,224	266.4	58.9
Dearborn	3,327,965	3,889,843	5,738,224	16.9	47.5
Ann Arbor	3,000,349	4,173,889	5,052,365	39.1	21.0
Livonia	689,100	2,032,640	3,365,558	195.0	65.6
Pontiac	2,481,832	2,508,332	2,581,252	1.1	2.9

Source: Greater Detroit Chamber of Commerce, *Office Guide*, 1991.

Southfield and Troy due to their relatively small populations. Data was, however, collected for Detroit in 1950 to provide a 'snapshot' of the city prior to the suburbanization of the population.

Neither occupation data nor labourforce data collected by the U.S. Census Bureau over the study period is consistently classified from census to census. New categories appear between census periods or existing categories are redefined. Furthermore, the labourforce data in particular was extremely difficult to manage due to the manner in which it was collected. Labourforce data was very finely broken down into categories, many of which appeared to change in description or were found under different economic sectoral groupings. These inconsistencies led to the decision to use the occupational census data.

The obvious drawback of this decision to use occupation data is that it does not specifically identify the number of jobs in each study area, but instead, the number of people living in the area employed in that field or occupation. However, use of this data is not inappropriate. According to Pisarski (1987), commuting to suburban jobs from suburban residences is on the increase, indicating a certain level of suburban autonomy and independence. Pisarski (1987) found that over twice as many suburban residents commuted to suburban jobs than to those in the central city in 1980. He also found that even the incidence of central city to suburban commuting was on the increase. Therefore, while occupational data may not provide

the best indicator of the distribution of economic activity across the various sectors, it can provide a reflection of the generalized trends and patterns. Furthermore, census totals of labour for Southfield and Troy suggest that throughout the study period both cities were actually attracting *employment*, not just employees. The total labour force within the cities are consistently higher than the total occupation, implying that both cities are exhibiting a certain degree of independence as opposed to merely serving as 'bedroom communities' (see Table 4).

Table 4.
Occupation versus Labourforce Totals

City	1960	1970	1980	1990
Southfield				
Occupation	10,815	27,581	38,049	39,725
Labourforce	11,964	28,555	40,405	42,187
Troy				
Occupation	6,244	16,545	30,352	39,292
Labourforce	6,980	17,136	34,370	40,623

(Source: U.S. Census 1960-1990)

Even with the occupation data groups, in order to be able to compare the data over several censuses several broad-based occupational categories were created out of all of those collected by the bureau. These aggregated categories were:

- Executive, Administrative and Managerial
- Professional Specialty Occupations
- Technical, Sales and Administrative Support
- Private Household Occupations
- Protective Service Occupations
- Service Occupations (other)
- Farming, Forestry and Fishing
- Precision Production and Repair
- Operators, Fabricators and Labourers

The creation of these categories from those defined by the U.S. Census helped ensure that the same groups were compared and analyzed over the duration of the study period.

Both Erickson's (1983) and Hartshorn and Muller's (1989) models of suburban development identify several periodic stages. Each of these stages in turn identify various levels of population growth and employment distribution across several economic sectors. For example, in Erickson's model, the "Spillover" stage is partially defined by the shifting of manufacturing employment from the inner city to the suburban peripheries. Erickson determined that the typical proportion of manufacturing employment in the peripheries to that of the inner city ranged from 15 to 23 percent between 1920 and 1940. Beyond such simple generalizations, neither Erickson nor Hartshorn and Muller actually *quantified* the stages of their models. However, the essence of their descriptive criteria can be compared to the collected data in order to provide a quantitative measure for their models and the state of urban development in Southeastern Michigan. The Southeastern Michigan Census population and occupation data allowed a simple comparison of many of the model stages to the past situation in the Detroit area, as well as providing insight into possible modifications or extensions of their stage model theories.

In addition to the analysis of the census occupation data, each suburban centre was also studied for changing land use patterns during their recent development and growth. In order to perform this analysis, land use data was obtained from both Southfield and Troy's planning departments and mapped. Due to the relative infancy of both of these suburban centres, very little land use information was available before 1970. Thus, only two maps were prepared for each of the urban centres, one for 1970 and one for 1992. The Troy maps depict the major centres of industry, commerce and office functions for the suburban centre. Southfield's historical land use information, however, has only recently been recorded by their planning department. As a result, the 1970 map of Southfield contains only generalized office centre information which was determined through the plotting of individual office buildings

constructed before 1970. Sufficient data for 1992 allowed for the preparation of a map of Southfield similar to that of Troy containing land use information on industry, commerce and office functions. Through a comparison between the two paris of maps it was possible to generalize land use patterns which emerged in the suburban population centres. The patterns were compared to the monocentric model of urban growth to determine whether or not it was appropriate.

Analysis

Testing of the hypotheses required analysis of the collected population and occupation data. The first and second hypotheses, regarding the degree of urban growth and decentralization among the three study areas, were evaluated through simple graphical procedures. The first step in the analysis of the data involved generating histograms of the occupation and population data for the three urban centres under study. In order to create a relative measure between Southfield, Troy and Detroit, the occupational class frequencies were converted to percentages. Histograms based on historical occupation and population data are a basic form of statistical analysis which illustrate general trends in the change of various economic sectors. These graphs indicated the growth or decline of population and occupational sectors amongst the three study areas. Only those categories of data were considered which represented a significant (i.e. greater than 5%) portion of the total occupation value. These findings were then used to identify important aspects of the data. Benchmark values were required to assess the relative measure of the data collected for the three urban centres. These were provided by examination of Michigan's occupational class frequencies over the 40 year period. Values were tabulated in a decade by decade summary of the data from Detroit, Troy, Soutfield and Michigan. This allowed an assessment of the variance of the individual cities' occupational class frequencies from those of the regional values for each decade.

Another portion of the statistical analysis involved generating a comprehensive correlation table on the three study areas. For each of the areas, the occupational frequencies within the

categories of labour were correlated to the year of the collected data. This produced a table of correlation values which indicated the level of correlation between the year of the census data and the number of persons in specific occupations. In other words, each occupation category could be assessed for degree of linear correlation relative to time. A high positive correlation value indicates a strong correlation with an upward sloping line, while a high negative value indicates a strong correlation with a declining line. This information provided a relative indication of how each labour category had changed over the study period. The correlation coefficients were calculated using the Pearson Correlation Coefficient formula[1].

The statistics generated through the histograms, tabulations and correlation analyses, in addition to the land use mapping, provided the necessary information to test the hypotheses proposed in the 'a priori' model. In order to examine the first hypotheses, that "...there is a decentralization of employment in Southeastern Michigan", the population changes and workforce levels were compared among the urban centres in a simple proportional analysis. Rates of growth over several periods were compared between the locations as were total employment levels as a proportion of the resident population. The tabulated data and correlation

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[1] Pearson Correlation Coefficient:

$$r^2 = (\Sigma X_i Y_i - (\Sigma X_i \Sigma Y_i / n))^2 / (\Sigma X_i^2 - (\Sigma X_i)^2 / n)(\Sigma Y_i^2 - (\Sigma Y_i)^2 / n)$$

Where:

r^2 = the correlation measure

X_i = the value of X at i

Y_i = the value of Y at i

n = number of observations

analyses were used to test the second hypothesis, that "...decentralization is selective by occupation and varies from place to place and through time".

Utilizing the conclusions derived from the testing of the first and second hypotheses, the universality of the Hartshorn and Muller (1989) and Erickson (1983) models (third hypothesis) were examined. Using the descriptions provided in the text of the two models, and based on the statistics, land use mapping and empirical observations made for Southfield and Troy, a qualitative measure of the success of the models were assessed. Additionally, an examination of the shifting land uses in the suburban centres were examined to test the fourth hypothesis that "...suburban centres do not necessarily develop from or towards a monocentric pattern".

CHAPTER 5

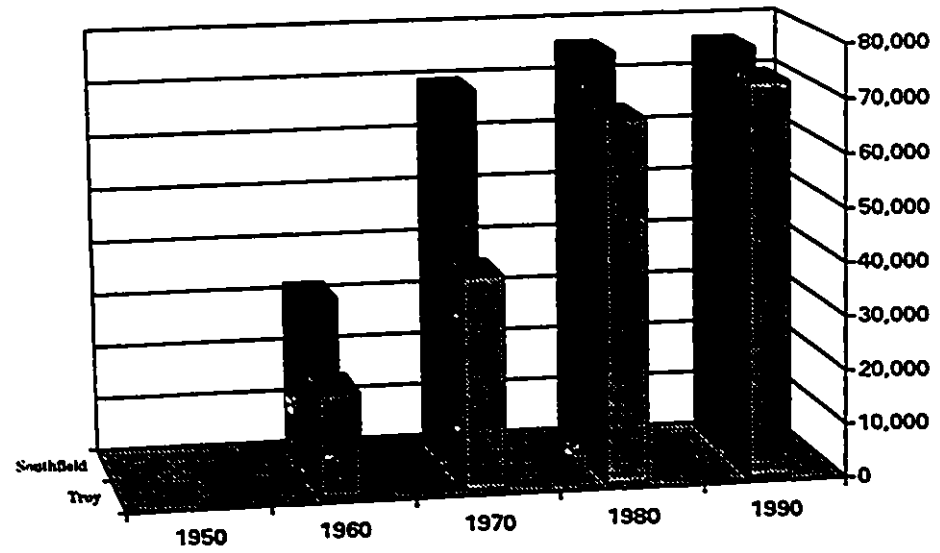
OBSERVATIONS

Peripheral growth

Most contemporary models of urban growth have highlighted the surge of peripheral growth around major urban centres in North America since the middle of this century. Erickson (1983) found that the average population growth of smaller suburbs (i.e. population less than 10,000) between 1939 and 1963 was 176.3 percent. Larger suburbs (i.e. population greater than 10,000) only increased by 37 percent over the same period. Southfield and Troy did not qualify as a "larger" suburb until 1960. In the time since 1960, however, the growth in these two suburbs was the greatest during the period between 1960 and 1970 (see Figure 3.). During this time, Southfield's population increased from 31,501 to 69,285--a growth of 119.9 percent. Troy experienced similar growth during this period, increasing from 19,058 to 39,419 (+106.8

Figure 3.

Southfield and Troy Population Levels

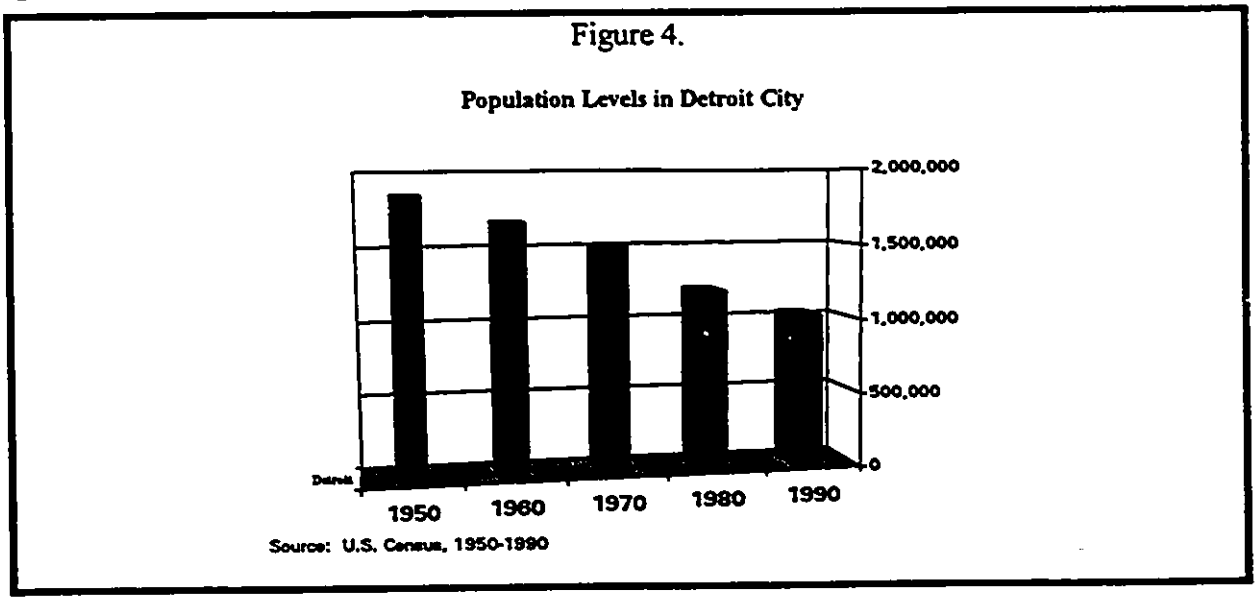


Source: U.S. Census, 1950-1990

percent). At the most recent census in 1990 Southfield and Troy's populations had both grown to exceed 70,000 persons.

Most North American cities have typically enjoyed this kind of peripheral growth. Few 'host' cities, however, have encountered the population loss that Detroit City has. The third stage of Erickson's model (1960-present) suggests that in most of the inner cities in the United States the population remained unchanged between 1960 and 1980, while the suburban population increased by 45 percent. However, in 1960 the U.S. municipal census indicated that Detroit City had a population of 1,670,144. By the 1980 census this figure had dropped to 1,203,339 (-28.0 percent). While annual decline was relatively constant over the 40-year period from 1950 to 1990 (see Figure 4.), the greatest decline occurred between 1970 and 1980 where the city experienced a population loss of 20.3 percent. Between 1950 and 1990, the population had actually decreased by a total of 44.4 percent. This population loss was likely accelerated by severe social unrest in the Detroit area in the late 1960's, culminating in the well-known riot of 1967. Outmigration, particularly of the white population, increased considerably during this period. The loss of inner-city population substantially reduced the available tax base which resulted in poorer municipal services, shifting investment patterns and declining employment figures. In fact, Detroit City lost 29.7 percent of its workforce between 1970 and 1980 alone.

Figure 4.



This suggests an additional influence upon urban growth, one which is extremely difficult to measure--the degree of social harmony within the urban area, or within particular parts of it.

Additional insight was provided by an examination of the proportion of people working to those living in each of the study areas. In Detroit City in 1950, for every one person working there were 2.47 people living within the city limits. This ratio has been decreasing steadily until in 1990 where there were 3.07 residents per working individual. Thus, considering the dramatic decline of the population in Detroit, one can conclude that the attractiveness of Detroit City as a place of work had declined even more dramatically than as a place to live. In contrast, the peripheral locations of Troy and Southfield have exhibited the opposite trend. While experiencing steady population growth over the past four decades, they have both exhibited decreased workforce/population ratios. In 1960, Southfield had 2.92 persons residing for every one person working, while Troy had 3.05. By 1990 these values had decreased considerably. At that time, there were 1.90 persons living in Southfield for every person working, while Troy has 1.83. Clearly there is a marked change in the preferences of those living in the southeastern Michigan area towards living *and* working in the suburbs. Also, these findings seem to support Hartshorn and Muller's second stage, where "...the suburbs were transformed from a dependency status to one of independence..." (Hartshorn and Muller, 1989, p.380).

Occupational Trends in Detroit

Census data for Southfield and Troy were not available for 1950 because of their small size at that time. Figures were, however, available for Detroit, and represent the situation prior to the major decentralization in Southeastern Michigan. Examination of the data for each subsequent census has revealed that workforce levels in Detroit have been steadily declining for at least the last four decades.

Bar charts of the three urban centres were prepared for the analysis of each occupational category. Of these, four of the eight occupational categories were found to represent a significant proportion of the total number of employed persons. This was determined by selecting the categories which had greater than 5 percent of the total number of employed persons. These were Executive, Administrative and Managerial; Professional Specialty Occupations; Precision Production and Repair; and Technical, Sales and Administrative.

Within the occupational categories of Detroit between 1950-1990, only two actually experienced positive growth in numbers. One of these was the "Protective Service Occupations", which experienced growth of 53.2 percent, with a temporal correlation (r^2) of 0.901, over the study period (see Table 5). This appears to support earlier assertions that social tension levels within the inner city can have a significant influence upon the direction of

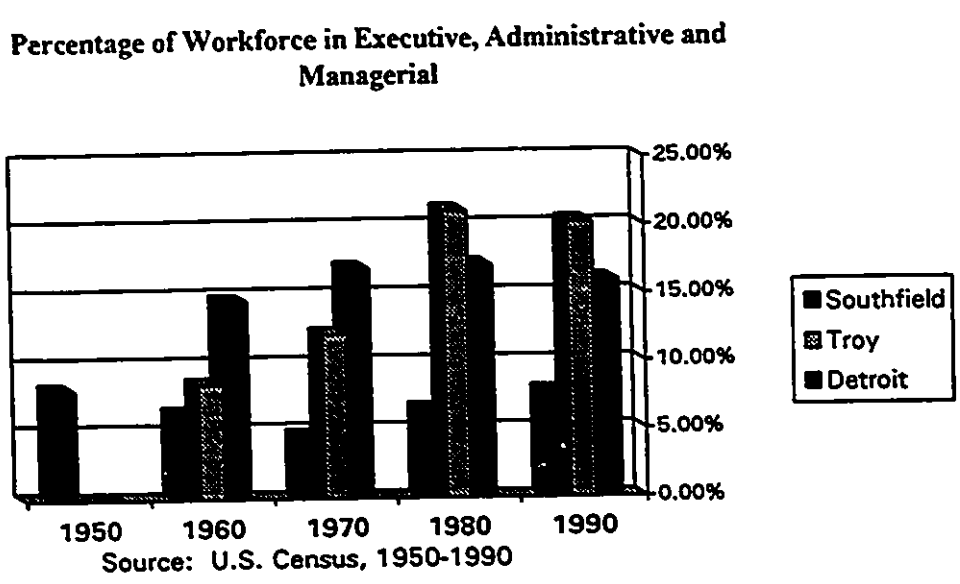
Table 5.
Correlation of Occupation versus Time
Number in Occupation Correlated with Time

Detroit, Michigan	*Years*
Years	1.00
Executive, Administrative and Managerial	-0.84
Professional Specialty Occupations	-0.88
Technical, Sales and Adminstrative Support	-0.99
Private Household Occupations	-0.91
Protective Service Occupations	0.90
Service Occupations (other)	-0.45
Farming, Forestry and Fishing	0.89
Precision Production and Repair	-0.97
Operators, Fabricators and Labourers	-0.97

economic growth. The only other category exhibiting absolute growth over the period was the "Farming, Forestry and Fishing" occupations (r^2=0.89, +295.2 percent), although this cannot be considered very significant since this category represents less than 1 percent of the occupation total of Detroit. All other occupational categories experienced a relative decrease and had very strong negative correlations with time, with r^2 values exceeding negative 0.8, except for "Other Service Occupations" which had a much weaker negative 0.45 correlation value. The strongest negative correlation was exhibited by the "Technical, Sales and Administrative Support" category (r^2=0.98, -64.7 percent), and "Precision, Production and Repair" categories (r^2=0.97, -418.9 percent)[2].

The selected comparative bar charts on occupational proportions show the changes over time in more detail. In Detroit City, the proportion of the workforce in "Executive, Administrative and Managerial" occupations was about 7.75 percent of the total workforce in 1990 (see Figure 5). This was on the increase after a decline in 1970 where its relative proportion of the workforce had dropped to 4.64 percent (although the greatest absolute decrease

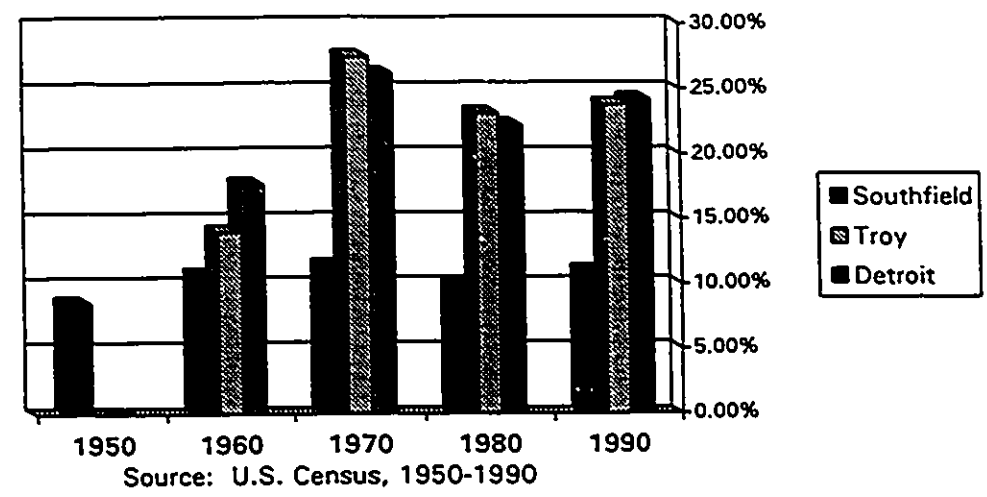
Figure 5.



[2] This variable appears to be a negative exponential distribution, thus explaining the r^2 value

in this category was between 1950 and 1960 with a net loss of 24,562 positions). The "Professional Specialty Occupations" is a category which has experienced one of the greatest

Figure 6.



degrees of proportional loss over the study period. In 1970, Detroit had nearly 64,000 persons employed in these occupations. By 1990, this figure had dropped to under 37,000 (-42.7 percent). Despite this, however, "Professional Specialty Occupations" maintained a relatively consistent portion of the total occupation proportion (see Figure 6). These specialty occupations are not directly involved in management level decision-making, and are often hired on a consultant/contract basis.

Occupational Trends in Southfield and Troy

Over the study period, many shifts in the mix of occupations have occurred in Southfield and Troy. The only occupational category which was negatively correlated with time for the suburban locations throughout the study period was "Private Household Occupations" with an r^2 value of -0.91 for Southfield and -0.24 for Troy (see Table 6). The net changes in this category were -56.0 percent and -17.0 percent respectively. This finding does not necessarily indicate

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being less than that of "Technical, Sales and Administrative Support"

some exclusively suburban phenomenon, but more likely a general change in the last 50 years respecting household occupations. This category has also dramatically declined in Detroit City from 12,918 workers in 1950 to merely 1761 in 1990. As the North American economy improved throughout the 1970's and 1980's, more and more individuals were able to find steady employment with businesses and corporations. The home occupation, it appears, may have been a phenomenon which was popularized by periods of economic uncertainty. During these times, individuals with limited employment opportunities may be forced to take matters into their own hands. By using available facilities and resources within the home they are able to minimize overhead and start-up costs of a business and decrease the financial risks involved. If this assumption is true, then the popularity of the home occupation could conceivably be on the increase in North America today, as the continent experiences one of the most severe economic recessions in recent history.

All other occupational categories in the suburban study locations exhibited positive correlations with the passage of time. This is a direct reflection of the substantial population growth of both suburban sites and does not necessarily indicate a relative increase. Relative increases are best identified by examining the proportion of the workforce in each of the

Table 6.
Occupation Correlation Table for Southfield and Troy
Number in Occupations Correlated with Time

Occupation	*Southfield*	*Troy*
Executive, Administrative and Managerial	0.91	0.98
Professional Specialty Occupations	0.92	0.99
Technical, Sales and Adminstrative Support	0.95	0.99
Private Household Occupations	-0.91	-0.24
Protective Service Occupations	0.97	0.97
Service Occupations (other)	0.98	0.95
Farming, Forestry and Fishing	0.90	0.62
Precision Production and Repair	0.72	0.90
Operators, Fabricators and Labourers	0.82	0.89

occupational categories. Perhaps the most significant of these increases in Troy occurred in the proportion of "Executive, Administrative and Managerial" occupations which grew from a mere 8.5 percent of the work force in 1960 to 20.3 percent in 1990 (r^2=0.977). Obviously, Troy's early strength was not in corporate control. Indeed, the town's occupational structure in 1950 was grounded in the production occupations. The largest occupational category at that time was that of "Operators, Fabricators and Labourers" with over 23 percent of the total workforce. By 1970, the "Professional Specialty Occupations" had become the largest group with a 27.5 percent share of the total workforce and "Technical, Sales and Administrative Support" was close behind with 24.9 percent. Thus, both Erickson's "Contemporary" phase and Hartshorn and Muller's "Independence" stage appear to have accurately identified the trend between 1960 and 1970 of middle- and upper-level management and research and development operations to remain within inner city locations while clerical functions, light industry, and sales offices gravitated towards peripheral locations. Another recent development has been the reversal of these two rankings. By 1990 the "Technical, Sales and Administrative" category had displaced "Professional Specialty" as the top ranking occupation (33.0 percent and 23.8 percent respectively). This trend was also identified by Hartshorn and Muller. In fact, they claim that in their fourth stage (High-Rise/High-Technology, 1980 to the present) the demand for clerical workers would exceed the local supply and that the suburbs would dominate the CBD in retail sales.

Several other trends were noted. The largest decline of any workforce group in Troy occurred in the "Precision Production and Repair" category with a drop in share from 21.3 percent to 8.1 percent (see Figure 7). Again, this observation might not be a local characteristic, but instead an underlying trend. This is supported by an examination of Michigan's occupational distributions, where this category has recently been on the decline. In 1960, the "Precision, Production and Repair" category in the state represented a workforce share of 18.4 percent (see Table 7). By 1990, it had dropped to 12.0 percent (see Tables 8-10). In the early stages of Troy's development, such occupations were still very much in demand by industry. At this time,

it became very popular to move these functions out of the congestion of the inner-city. Precision, skilled labour in North America, however, has lost its relative importance when compared to developing countries in the global market. Also, the introduction of computer controlled, automated systems in manufacturing industries have increased the productivity per worker, allowing fewer employees to meet the needs of the industry's firms. In the place of these precision jobs are the new, emerging professional specialty, technical and administrative support occupations associated with a predominantly white-collar workforce--occupations which appear to have found a place in the suburban niche of the metropolis.

Table 7. Occupational Composition of Selected Sites, 1960

	Michigan	Detroit City	Southfield	Troy
Managerial and Professional				
Executive, Administrative and Managerial	5.43%	6.37%	14.64%	8.46%
Professional Specialty Occupations	8.89%	10.74%	17.70%	14.00%
Technical, Sales and Adminstrative Support	25.47%	25.86%	26.49%	22.36%
Service Occupations				
Private Household Occupations	1.61%	2.73%	1.39%	1.60%
Protective Service Occupations	1.15%	1.54%	0.68%	0.80%
Service Occupations (other)	9.46%	9.52%	5.53%	6.53%
Farming, Forestry and Fishing	2.17%	0.06%	0.23%	1.57%
Precision Production and Repair	18.38%	14.03%	18.80%	21.32%
Operators, Fabricators and Labourers	27.43%	29.16%	14.54%	23.37%

Table 8. Occupational Composition of Selected Sites, 1970

	Michigan	Detroit City	Southfield	Troy
Managerial and Professional				
Executive, Administrative and Managerial	6.71%	4.64%	16.91%	12.09%
Professional Specialty Occupations	10.71%	11.39%	26.21%	27.48%
Technical, Sales and Adminstrative Support	27.63%	25.13%	30.31%	24.93%
Service Occupations				
Private Household Occupations	0.98%	1.66%	0.55%	0.27%
Protective Service Occupations	1.27%	1.80%	0.50%	0.88%
Service Occupations (other)	10.37%	12.57%	5.96%	5.40%
Farming, Forestry and Fishing	1.91%	0.16%	0.04%	0.10%
Precision Production and Repair	15.90%	12.40%	9.39%	15.26%
Operators, Fabricators and Labourers	24.53%	30.25%	10.13%	13.58%

Table 9. Occupational Composition of Selected Sites, 1980

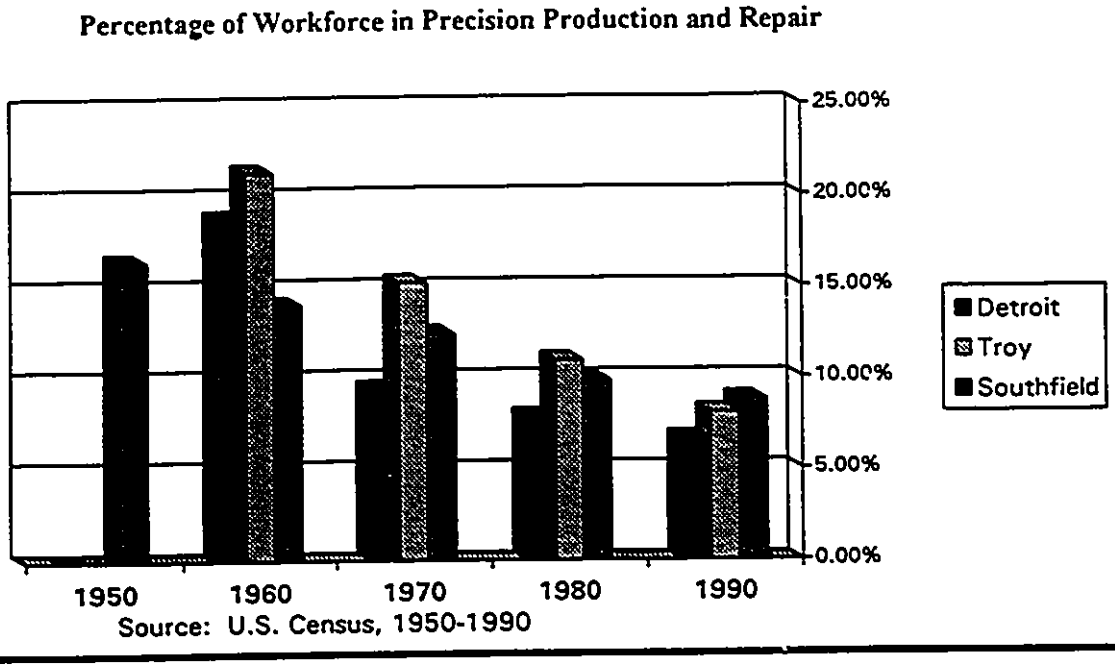
	Michigan	Detroit City	Southfield	Troy
Managerial and Professional				
Executive, Administrative and Managerial	9.17%	6.52%	17.13%	21.09%
Professional Specialty Occupations	12.24%	10.05%	22.21%	23.16%
Technical, Sales and Adminstrative Support	29.18%	29.74%	38.02%	26.54%
Service Occupations				
Private Household Occupations	0.46%	0.79%	0.20%	0.14%
Protective Service Occupations	1.48%	2.93%	0.71%	0.96%
Service Occupations (other)	12.00%	14.99%	6.75%	8.19%
Farming, Forestry and Fishing	1.67%	0.27%	0.20%	0.27%
Precision Production and Repair	13.17%	9.85%	7.85%	10.97%
Operators, Fabricators and Labourers	20.64%	24.86%	6.91%	8.69%

Table 10. Occupational Composition of Selected Sites, 1990

	Michigan	Detroit City	Southfield	Troy
Managerial and Professional				
Executive, Administrative and Managerial	11.07%	7.75%	16.00%	20.26%
Professional Specialty Occupations	13.61%	10.99%	24.21%	23.83%
Technical, Sales and Adminstrative Support	30.78%	31.36%	37.11%	33.04%
Service Occupations				
Private Household Occupations	0.31%	0.52%	0.17%	0.21%
Protective Service Occupations	1.59%	4.02%	0.75%	0.78%
Service Occupations (other)	11.82%	15.49%	7.30%	6.76%
Farming, Forestry and Fishing	1.57%	0.54%	0.46%	0.50%
Precision Production and Repair	12.04%	8.78%	6.64%	8.08%
Operators, Fabricators and Labourers	17.21%	20.55%	7.37%	6.52%

Southfield exhibited many of the same characteristics as Troy in its development throughout the last four decades, with one notable exception. The "Managerial and Professional" occupations in Southfield by 1990 had developed to represent a dominant share of the labour force with "Executive, Administrative and Managerial" representing 16 percent of the workforce and "Professional Specialty Occupations" 24.2 percent. However, in 1960 Southfield already had high representation in both these categories, with proportions of 14.6 percent and 17.7 percent respectively. "Technical, Sales and Administrative Support" was also very high in 1960 with a representative percentage of 26.5 percent (see Figure 8). This difference between

Figure 7.

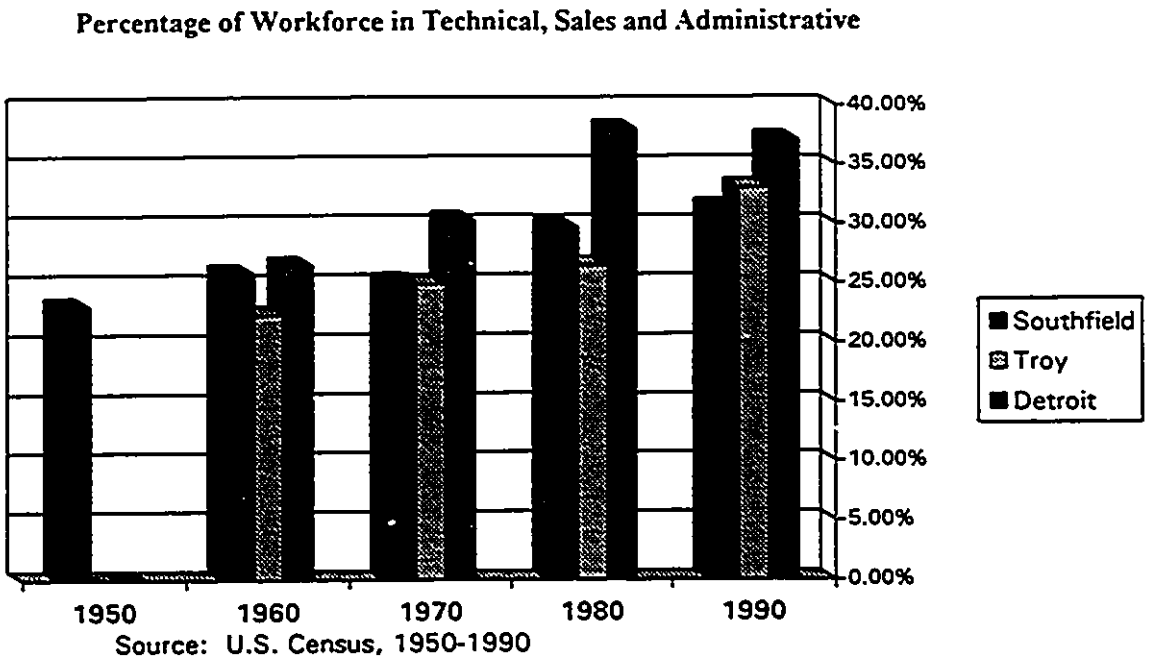


Troy and Southfield seems to suggest that the two centres were not perceived in the same light by the firms moving into them during the early stages of suburbanization.

Early on, Troy appears to have been characterized by its skilled blue collar labour force while Southfield tended to attract more of the white collar control functions and professional support occupations. Erickson's "Spillover and Specialization" and "Dispersal and Diversification" stages (1920-1940 and 1940-1960) appear to generally accommodate these findings. Erickson (1983) claims that the 1920-1940 period saw spillovers from industrial operations locate in the suburbs while management functions controlling these operations remained in the inner-city. He claimed that these locations gained in popularity in the period of 1940-60 due to expanded or improved transportation technologies and attracted virtually every type of operation. Hartshorn and Muller (1989) did not envision the higher-order management functions reaching the peripheries until the 1970's. Southfield's high representation in control and management occupations early in its development appears to be the only major contradiction to the model.

The two suburban areas in this analysis seem to indicate that these locations are not immune to shifting patterns of occupation proportions. In fact, they may be influenced at the exact same time as the 'host' city and, on a larger scale, the entire state (see Tables 7-10). In 1960, for example it appeared that roughly 25 percent of the labourforce was employed in Technical, Sales and Administrative Support positions, irrespective of nature or size of the urban centre. By 1980, Southfield had attracted considerably more people employed in Technical, Sales and Administrative Support (38.0 percent) than Detroit City (29.7 percent) and the State (29.2 percent). Perhaps even more significant is the observation that both suburban locations have evolved near-identical labourforce proportions between occupational categories, despite displaying significantly different initial conditions. Contemporary research in astrophysics, fluid dynamics, systems analysis, and many other disciplines have been identifying the importance of initial conditions in systems. Since the early development of Southfield and Troy indicated greatly differing specialties, one would expect them to evolve into two completely dissimilar centres. This, however, was not the case. The gradual convergence in occupational characteristics for the two centres in Southeastern Michigan may indicate that some underlying influence may be present in urban systems which is over-riding the chaotic forces observed in the physical sciences. It is likely that future research may identify the source of this influence originating in the host city.

Figure 8.



Another interesting consideration is the proposition that the City of Auburn Hills may represent what could be called a "third layer" in the hierarchy of suburbanization. As of the last census, the total workforce living in Auburn Hills was 9,954. If this figure increases steadily over the next several decades and physical and economic characteristics appear similar to those in the infancy of Southfield and Troy, then Auburn Hills may represent the first suburban downtown *of a suburban downtown*, namely Southfield, in southeastern Michigan. If this is the case, then the specialization of Auburn Hills' workforce should be one which would complement that of Southfield. Indeed, Auburn Hills is well-represented in the "Operators, Fabricators and Labourers" category, much like Southfield and Troy of the 1960's, with a representation of 13.5 percent.

Suburban Land Use Patterns

Hartshorn and Muller (1989) suggested that a true 'suburban downtown' should provide employment for at least 50,000 persons. They claim that these entire centres can be considered;

"...full-fledged "downtowns" in the classic sense, because they have become the crossroads of their portion of the outer suburban city with superior freeway/highway access and have attracted a diversified mix of commercial activity. To be sure, they look different from the traditional central-city CBD. Suburban downtowns are more loosely knit together, so to speak, with islands of nearby development often scattered across a sea of parking lots and/or decks. And, of course, they are far more auto-oriented than pedestrian-oriented, but they still function along the lines of the CBD-type downtown...Typically these centres serve as corporate headquarters locations as well as the nexus for high-order support services..." (Hartshorn and Muller ,1989, p.376).

But do Southfield and Troy qualify as such 'downtowns'? Indeed, there are many similarities. In both suburban centres, office development is the predominant component in the local economic base. Both centres appear to represent the major focus of activity in their portion of the suburbs. Other criteria of inclusion identified by Hartshorn and Muller (1989) are summarized in Table 11.

Table 11.
Southfield and Troy as "Suburban Downtowns"

Hartshorn and Muller Criteria:	**Southfield**	**Troy**
• one regional mall of 1,000,000 square feet	☑ Northland Shopping Centre (1,626,758 square feet)	☑ Oakland Mall (1,400,000 square feet)
• five million square feet of office space	☑ 21,000,000+ square feet	☑ 14,900,000+ square feet
• three of more high-rise offices	☑ 8 offices greater than 15 floors each	☒ 2 offices greater than 15 floors each
• at least one Fortune 1000 firm headquarter	☑ Two. Lear Holdings (281), Thorn Apple Valley (426)	☑ Three. K Mart (Ret 3), Standard Federal Bank (Sav 6), Kelley Services (Ser 76)
• two major hotels of more than 400 rooms each	☑ Three. Holiday Inn (421), Plaza Hotel (404), Radisson Plaza (427)	☒ None. (Marriott Detroit (354), Guest Quarters Suite (251))
• total employment of 50,000	☒ 42,187	☒ 40,623

Neither centre, however, has developed a recognizable central business district which would compare to anything found in the cores of traditional central cities. In early urban

systems research, it was the core of the city which was viewed as the focal point of all subsequent concentric growth. Burgess' (1925) concentric ring theory was the most widely accepted model predicting this kind of growth. The development of Southfield has assumed a relatively linear form which corresponds to the freeway access provided by the Highway 10 radial originating in Detroit City. While this highway has attracted a diverse mix of commercial activity where it crosses Southfield, these commercial centres appear to be strongly geared towards providing the nearby (or attached) office complexes with services. In the early development of the city (see Figure 9), the arrangement of office activity was discontinuous, albeit clearly centred around the highway. As Southfield evolved over the years, a sense of agglomeration need seems to have prevailed. Younger firms may have been seeking suburban sites such as Southfield to provide them with an incubational climate in which they could develop. Offices began to coalesce into 'office centres' and 'office parks', which further attracted commercial and business service centres. By 1992, these centres had come to represent a significant aspect of Southfield's urban morphology (see Figure 10). The bulk of activity in Southfield has become strongly focused around the Highway 10 corridor, with radial branches along major intersecting streets accommodating mostly office park developments.

The evolution of Troy was very similar to that of Southfield. The character of the city's early land use distribution was one of fragmentation. Office functions were found scattered throughout the area. The location of commercial activity showed little indication of an attempt to capitalize on the workforce captive at these locations (see Figure 11). Despite a highway radial providing rapid transit to and from Detroit which meandered through Troy, there seemed to be little interest in location at its interchanges. The seemingly random scatter of office functions and commercial activity gives little indication of land-use planning at any level. However, by 1992, the arrangement of land uses in Troy was very similar to Southfield's. Development was concentrated along the interstate highway I-75, and there appears to be no clear focus of activity (see Figure 12). Corridors of office functions, typically office parks, are

found branching away from the main corridor of activity. Commercial activity has been typically attracted to sites high in employment concentration, as opposed to areas of dense residential activity.

Both Southfield and Troy indicate a departure from the classic interpretation of the advent of non-suburban urban centres. As opposed to urban growth in inner cities which progressively develops outwards from an initial concentration of activity, these centres have developed from a scattered arrangement and mix of uses to a predominantly linear corridor of employment centres surrounded on either side by residential uses. The lack of a recognizable initial core appears to have influenced the system. Instead of growth being attracted towards the security and stability of a CBD, it has been forced to settle for the benefits of an improved level of transportation provided by highway location.

Figure 9. Land Use Patterns
Southfield 1970

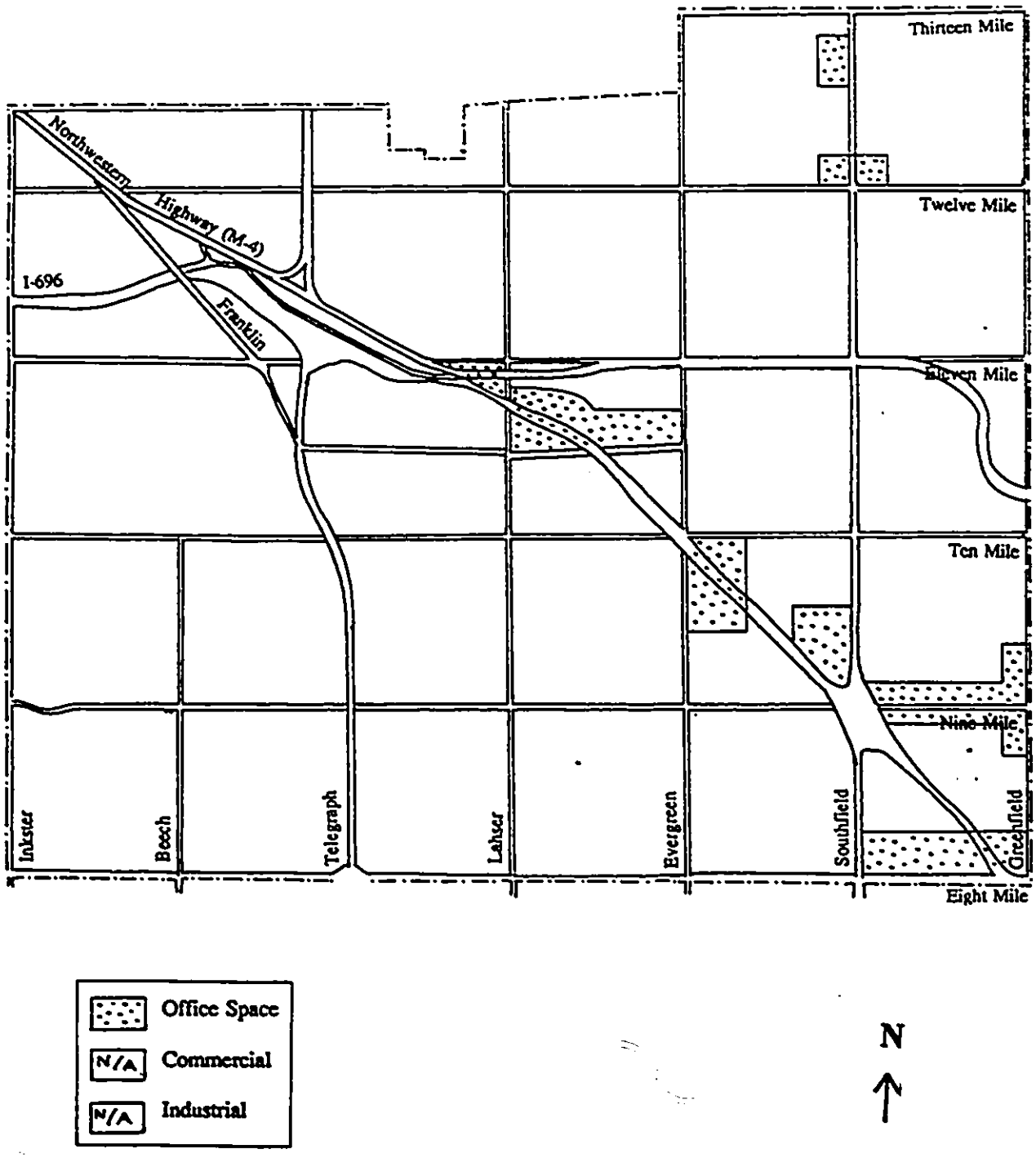


Figure 10. Land Use Patterns
Southfield 1992

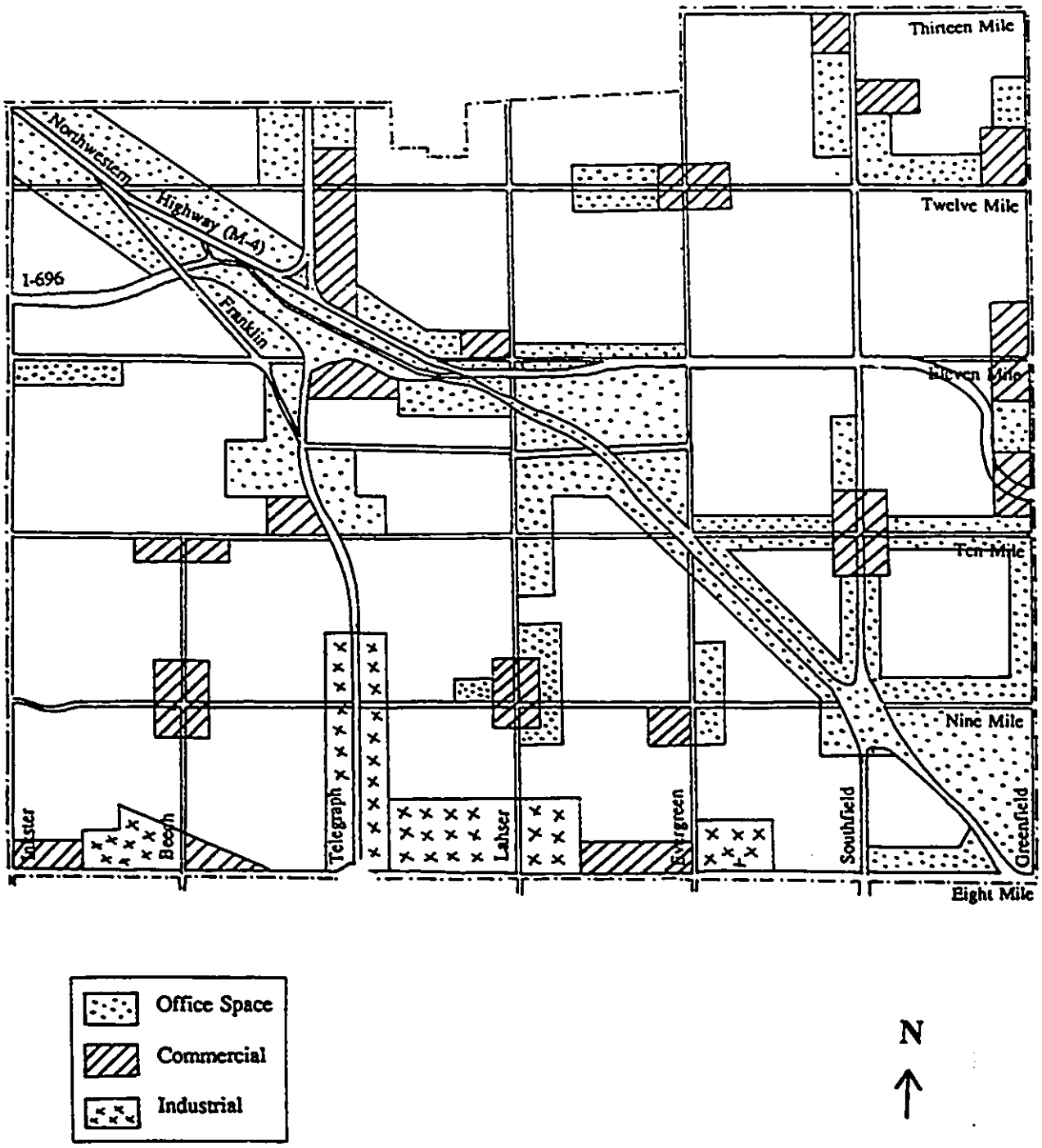


Figure 11. Land Use Patterns
Troy 1970

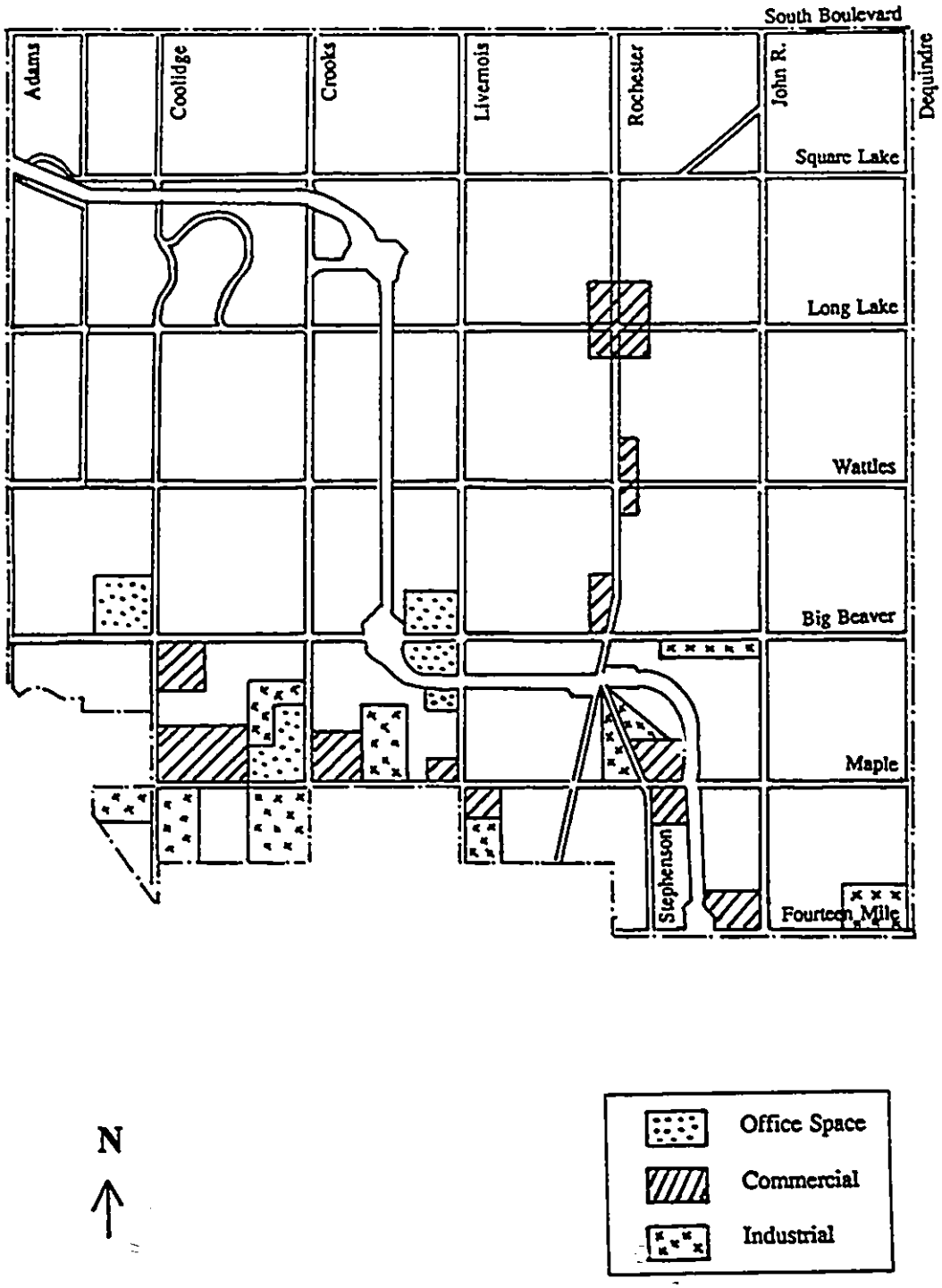
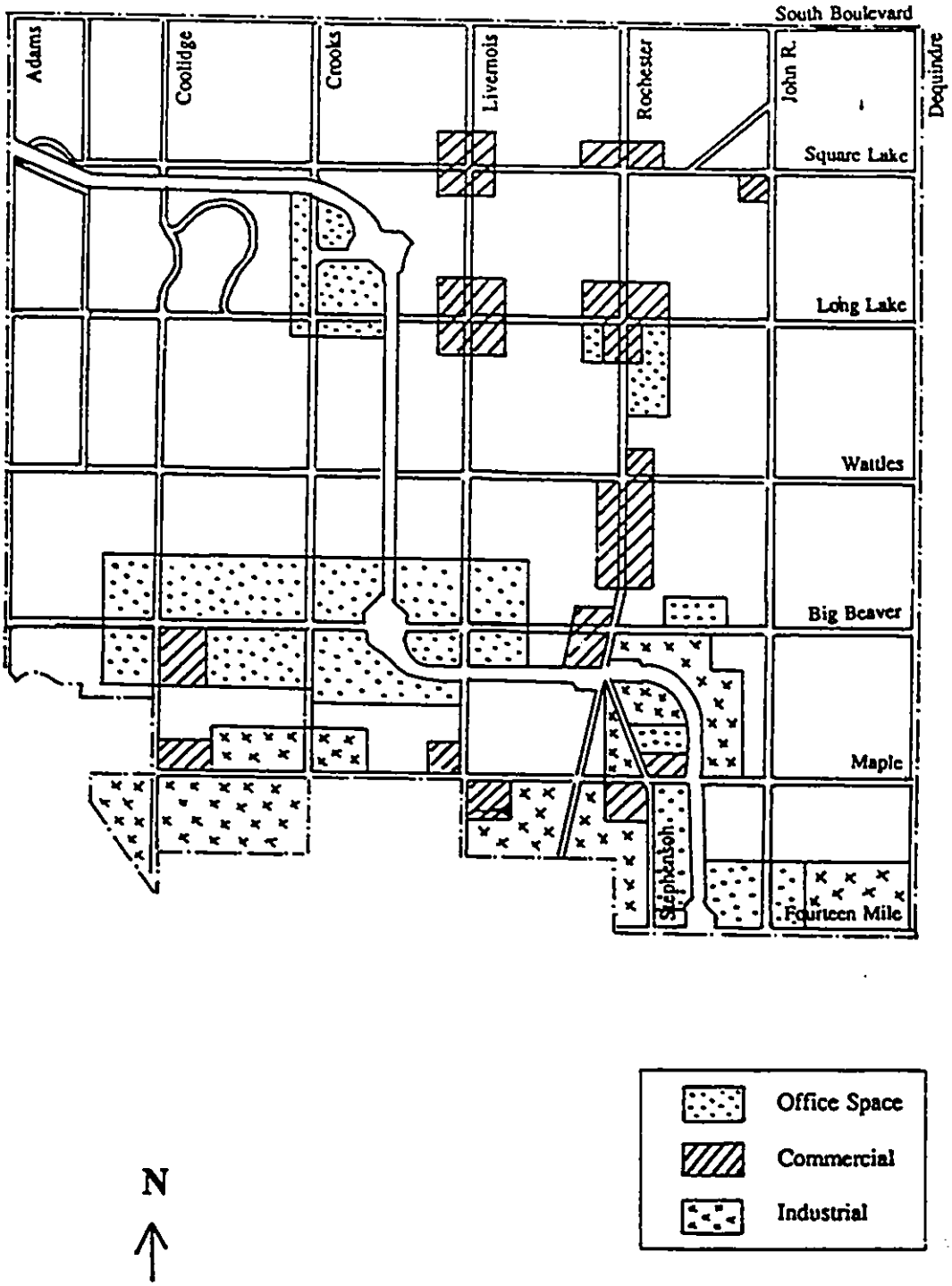


Figure 12. Land Use Patterns
Troy 1992



Conclusions

The first hypothesis postulated that "...there is a decentralization of employment in Southeastern Michigan". The population and workforce figures support this hypothesis. The dramatic exodus of labour and residents from Detroit over the last 40 years suggested the existence of both 'pulling' forces towards suburban locations as well as 'pushing' forces out of the inner city. This obvious decentralizing effect suggests the possible existence of a general decentralizing attitude in locational decision-making.

The second hypothesis, that "...decentralization is selective by occupation and varies from place to place and through time", was also addressed through examination of the changes in occupation categories. The proportion of labour represented in each of the categories was examined over the study period in an effort to identify labour specialization within the suburban centres. These proportions indicated changing characters within the suburban centres, suggesting different directions of specialization. Each of the cities evolved from being centres of production and fabrication early in their development to ones oriented more towards technical and administrative.

Many of the similarities and differences between the development of the suburbs of Detroit and the various stages of both Hartshorn and Muller's (1989) and Erickson's (1983) models of urban growth were identified. These observations seemed to indicate changing perceptions of the suburbs in addition to identifying strengths and weaknesses in both of the models. Thus, it is suggested that the third hypothesis, stating that "...the models of both Hartshorn and Muller (1989) and Erickson (1983) are valid and applicable to Southeastern Michigan", is partially, but not completely, supported by the research. The fourth hypothesis, that "...suburban centres do not necessarily develop from or towards a monocentric pattern", was supported by examination of the maps identifying the existing land use pattterns in Southfield and Troy as well as the changes since 1970. The monocentric model does not adequately describe the urban morphology of either suburban city. The 'linear' commercial development

within both cities suggests additional forces or influences which were not accommodated by the Burgess (1925) model.

A great deal of emphasis was placed upon examination of the existing models of Hartshorn and Muller (1989) and Erickson (1983). The research on Southfield and Troy supported many aspects of both models, as well as providing insight into other relevant points. These are summarized below:

- based on declining population levels in Detroit accompanied by similar growth in Southfield and Troy over the study period, Erickson's model accurately accounted for 'spillover' to the suburbs in the early part of this century
- suburban growth in Southeastern Michigan was the greatest between 1960 and 1970, thus supporting both Hartshorn and Muller's and Erickson's models
- steady increases in activity and employment opportunities suggests Hartshorn and Muller's predicted transformation of suburban dependence to independence has appeared in both Southfield and Troy
- while both Southfield and Troy exhibit many of the descriptive characteristics of a 'suburban downtown' as suggested by Hartshorn and Muller, some of the other criteria require revision
- despite differing initial conditions, both Southfield and Troy developed into cities with remarkably similar physical and occupational characteristics
- both Erickson's "Contemporary" and Hartshorn and Muller's "Independence" phases accurately modeled the 1960-1970 decentralization of clerical functions, light industry and sales offices in Southfield and Troy
- social factors likely played a large role in the decentralization of population from Detroit City to the suburbs
- Hartshorn and Muller and Erickson's models should be revised to allow for the possibility of a city such as Auburn Hills emerging as a 'suburb of a suburb'

- the monocentric model of urban growth does not necessarily apply to cities resulting from the suburbanization of large urban centres

It would seem that the models of Hartshorn and Muller (1989) and Erickson (1983) have successfully created a solid framework for this field of research by providing future researchers a base upon which to build knowledge. Neither model, however, was likely intended to be universally applicable and revisions may be merited. Further research in this field should identify and examine additional factors and influences which will complement their efforts.

CHAPTER 6

SUGGESTIONS FOR FURTHER RESEARCH

"Suburban Downtowns"

Several key questions must be asked at this stage in suburban modeling research. Does some clear quantification exist which can definitively distinguish a true suburban downtown from merely a population concentration which is located some distance from a much larger urban centre? And furthermore, are precise concepts and parameters possible at this stage in the development of suburban model research? Empirical research is always bound by the data available to the researcher. In these early stages of suburban research data is not readily available as in other fields. Fortunately, however, the state of suburban research has created an actual need for generalizations to preceed the specific, rigid definitions which could only be facilitated by the availability data. It is upon these generalizations that future researchers can contribute knowledge of the field. The usefulness of the qualitative theories and models which have been emerging should not be understated. They represent the foundations for further research which could some day lead to more strict analytical procedures and conclusions. At this time, suburban research may not require the levels of precision demanded by other 'established' disciplines.

The method of defining a 'suburban downtown' should be based on characteristics of the host city. For example, it is quite clear that the city and its suburbs exist in a symbiotic state in a relationship which involves the labour force. One *could* consider a suburban location to be a true 'downtown' when its total labour force exceeds a critical proportion of that of the host city's central business district. Considering the extensive linkages which must exist between the centres, an obvious additional requirement would be that the suburban location be found within a certain temporal travel radius (eg. 30 to 40 minutes) of the host city, . When the suburban

location labour force exceeds the proportion and where it is within the maximum travel radius it becomes able to effectively compete with the host city in attracting activity. Thus the 'suburban downtown' could be defined as being less of a physically observable entity and more of a political phenomenon.

Linear modeling

Research in the field of urban modeling has typically reflected the changing times and conditions. When Burgess first proposed his 'monocentric' model in 1925, there were very few influences affecting location decisions other than the desire for security and a need for interaction. The 'distance gradient' of land value during this time was a very real phenomenon. Over time however, transportation and communication facilities improved which reduced the friction of distance, allowing the boundaries of interaction to spread over larger areas. These changes allowed certain regions to develop characteristics which were particularly suited to certain operations and functions. Urban growth modeling needed to take into consideration these societal and physical changes, resulting in Hoyt's 'sectoral' model in 1939. More recently, changing perceptions towards the quality of life and cost-effectiveness of certain functions and operations in the inner city have pushed many activities towards the peripheries and out into suburban locations. Erickson identified these trends in his three-phased model and described the general characteristics of various nodes of attraction. These nodes, such as suburban intersections of radial highways and beltways around large metropolitan centres, attract development and become nuclei of a much larger 'poly-nuclear' system.

All of these models of urban growth are valid--under certain circumstances. Indeed, the geographic simplicity of the earlier models can be justified when one considers the state of the society and technology of the time. It appears to this researcher, however, that linear models of urban growth (those which provide only a single possible outcome) are increasingly inappropriate when one considers all the variables which affect location decisions today. A more appropriate approach would be one which recognizes that initial conditions, however

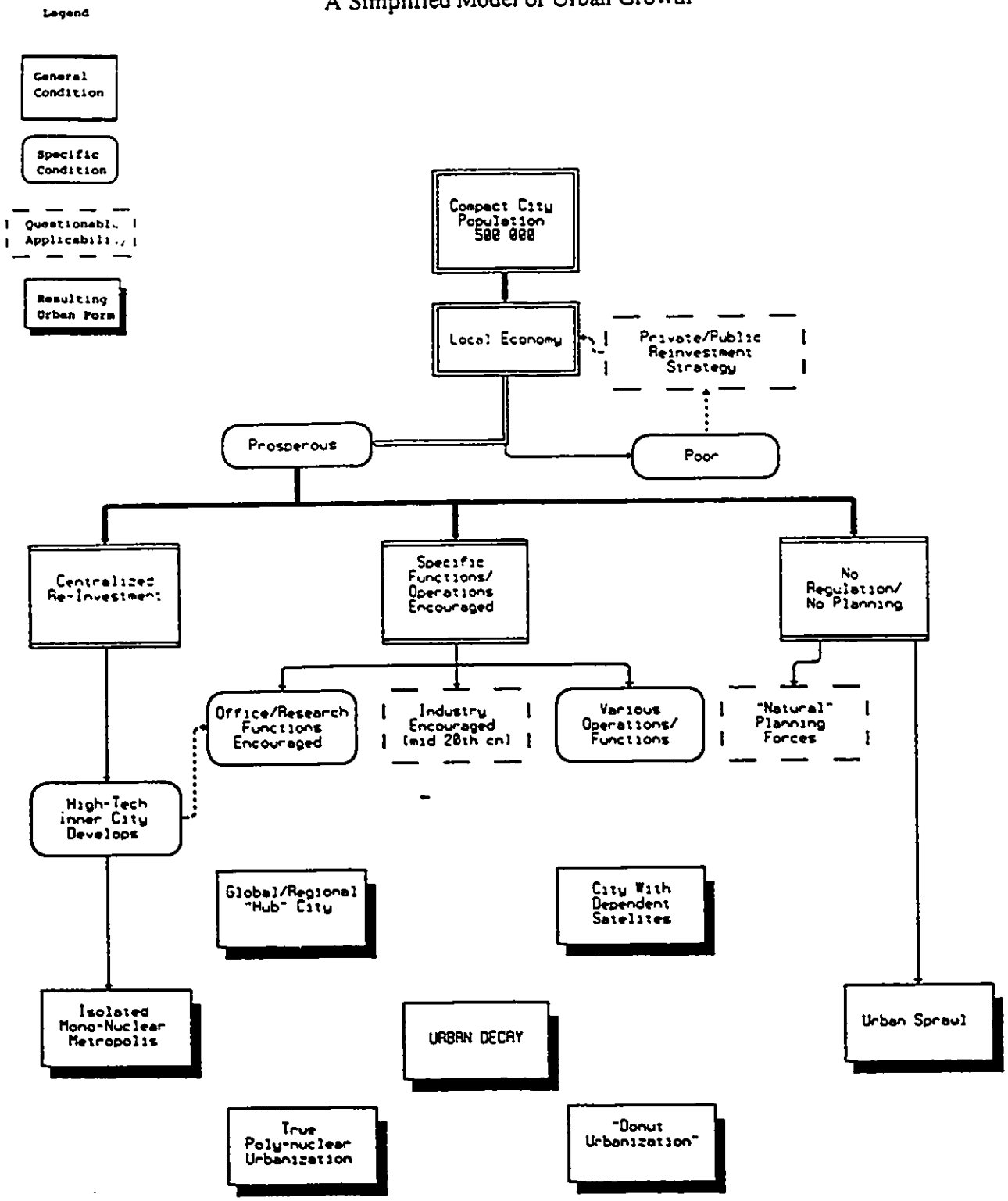
seemingly insignificant, can have dramatic impacts upon the ultimate morphology of a city. Lorenz (1979) identified the importance of initial conditions in systems with the 'butterfly effect' of chaotic mathematical modeling. Under this principle, the flapping of a butterfly's wings in Brazil can, in theory, ultimately cause a tornado weeks later in Texas. The initial conditions of air disturbance caused by the wings of the butterfly, over time, translate into much more significant events. The same principle can also be applied to the growth of a city.

A non-linear model of urban growth

With an understanding of the impact of initial conditions on a system comes an appreciation for the inappropriateness of linear, single-outcome modeling. Surely the multitude of conditions and variables which affect urban growth patterns must result in more than a single end-product. By using such an approach, the problem of identifying major influences which shape and alter the growth patterns and arrangements of cities would be greatly simplified. Although highly ambitious, an experimental model is proposed here which attempts to address the possibility that a non-linear approach to urban modeling is the most appropriate one (see Figures 13,14).

A North American city with a population of approximately 500,000 was selected as the starting point for this model. This threshold was selected for this model as it appears to represent the point at which many large metropolitan centres begin wide-spread, specialized suburbanization of population and functions. However, with further research and modifications to the categories in this model, it is conceivable that this approach could be extended to cities with a wider range of populations. Also, European cities appear to have significantly different 'initial conditions' which would likely preclude them from developing according to this model. Future study of the differences between the early urban conditions of European and North American cities could be conducted in order to contribute towards the development of a more general model of urban growth.

Figure 13.
A Simplified Model of Urban Growth



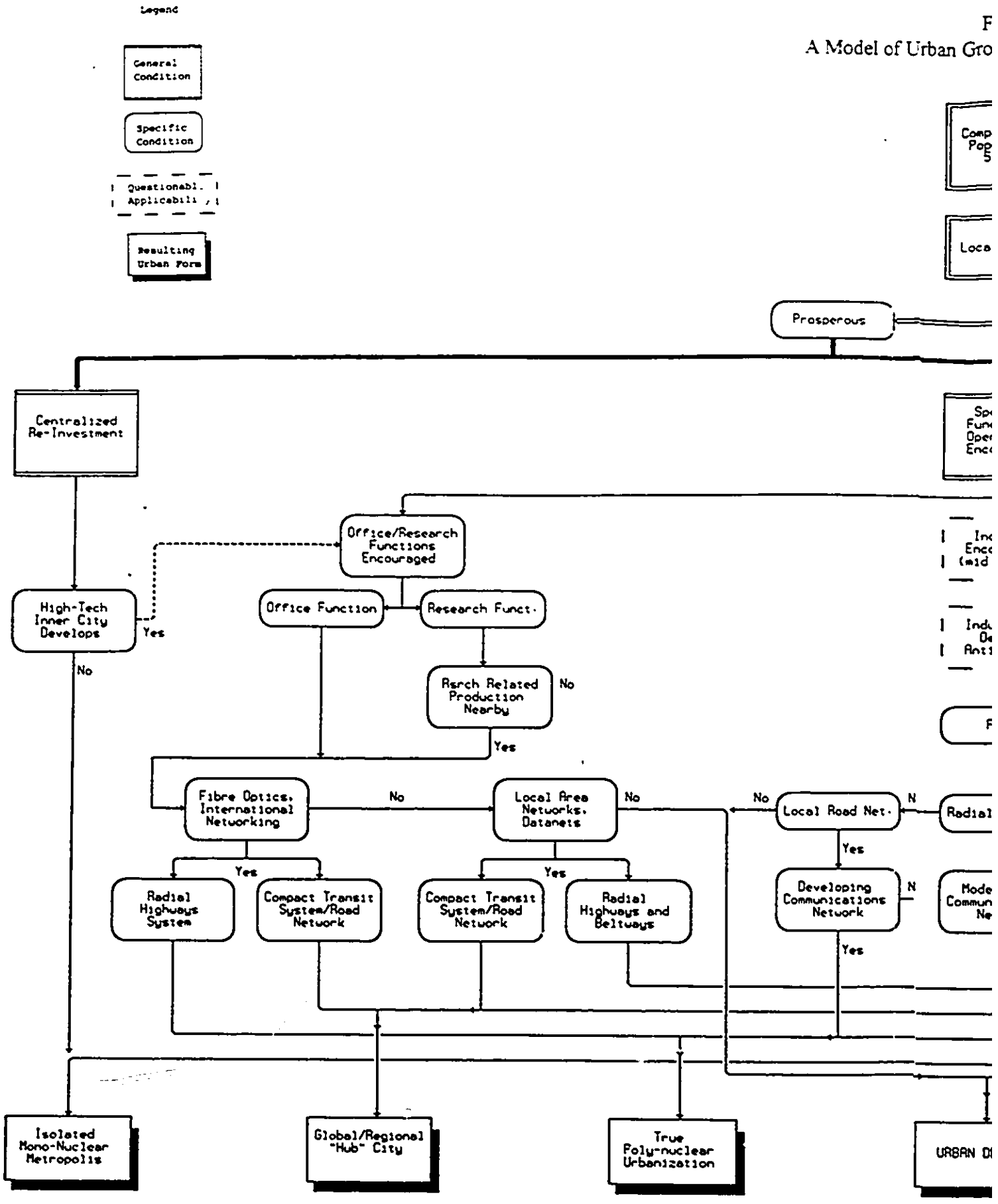
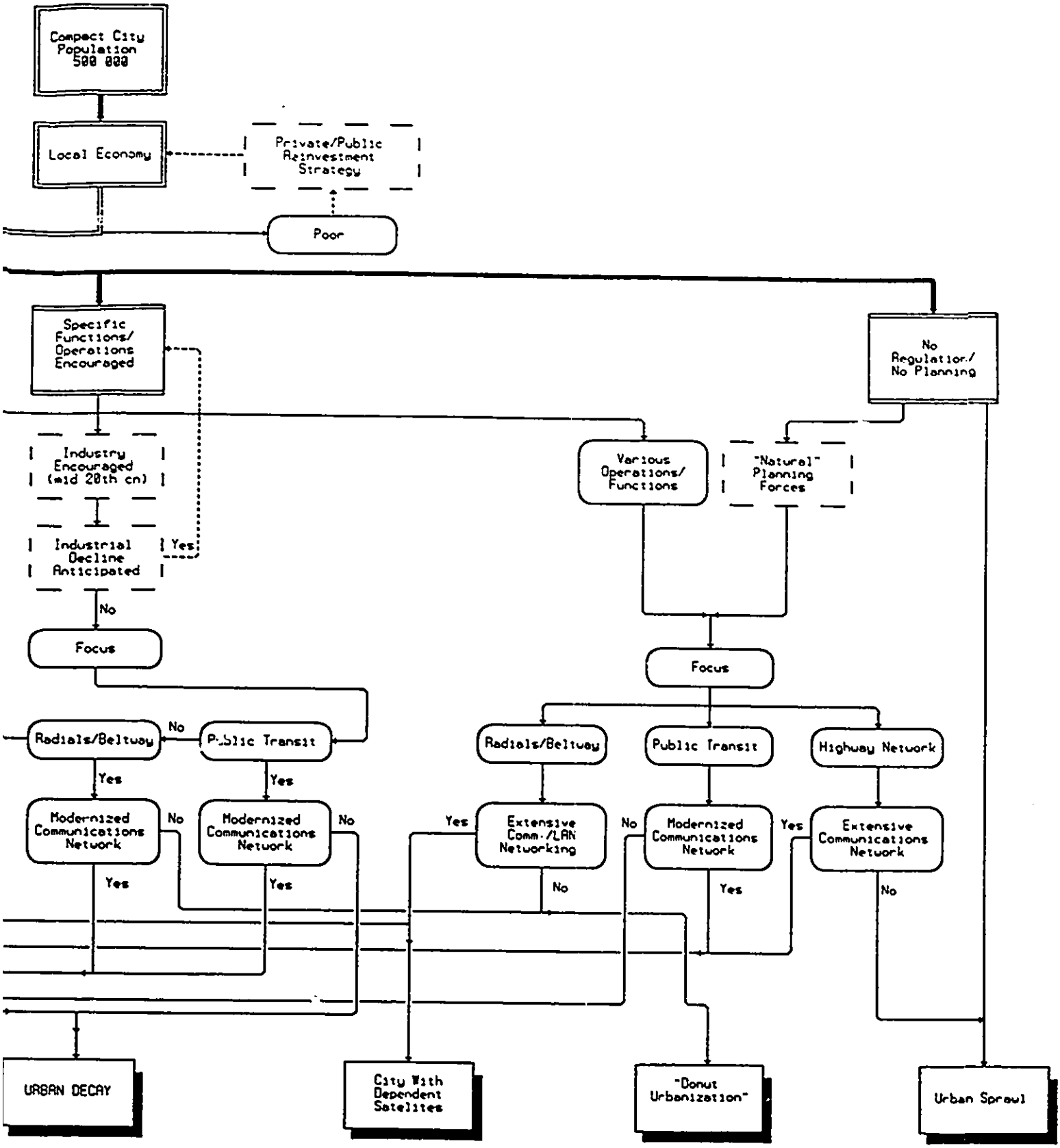

Legend
General Condition
Specific Condition
Questionabl.
Applicabili
Resulting Urban Form
Prosperous
Centralized Re-Investment
High-Tech Inner City Develops
Yes
No
Office/Research Functions Encouraged
Office Function
Research Funct.
Asrch Related Production Nearby
No
Yes
Fibre Optics, International Networking
No
Local Area Networks, Datanets
No
Local Road Net.
N
Yes
Radial Highways System
Compact Transit System/Road Network
Compact Transit System/Road Network
Radial Highways and Beltways
Developing Communications Network
N
Yes
Yes
Yes
Isolated Mono-Nuclear Metropolis
Global/Regional "Hub" City
True Poly-nuclear Urbanization

Figure 14.
Urban Growth for North American Cities



A healthy economy is perhaps one of the most important initial conditions necessary for urban growth to occur. Without capital flow and investment there is little possibility of any economic development occurring. Thus, "local economy" represents the first choice in the 'decision tree' of this model. A city with little economic growth will remain virtually unchanged and 'loop' back to the initial state. Otherwise, the city will move ahead to the next stage where investment and development directions are taken into consideration. The model accommodates a wide spectrum of reinvestment possibilities--ranging from exclusively centralized growth to growth that is indiscriminate and without planning. The middle bands of this spectrum represent the most common scenarios. It is here that a city adopts a specialized direction of development. In the middle of this century, many cities embraced industry and aggressively attempted to attract "smokestacks". Others sought a delicate balance between heavy industry and the commercial, agricultural and information sectors. Today, with the emergence of the Information Revolution, one increasingly finds that attempts are being made to develop cities into centres of information production which are characterized by concentrations of offices and research and development centres.

The next series of considerations in this model involves the state of development of the local transportation and communications facilities. Obviously, a city which experienced a significant degree of growth in "Office and Research Functions" would be wise to strengthen the communication facilities, considering the need for easy, reliable information flow. On the other hand, a formerly industrial city which has been hard hit by recent shifts away from heavy manufacturing in North America may have routed highway radials and beltways out of the inner city in order to facilitate travel out of the less-attractive core. A well-balanced city consisting of a healthy mix of commerce, industry and administrative labour may have city decision-makers who decide that compactness and centralization of transit (through the use of subways and busses) and expanded communication networks (such as Local Area Networks, and Wide Area Networks) would be advantageous.

Depending on the resolution of these factors, the model indicates a simplified description of an urban/suburban morphology which describes the selected city better than any of the other options. Of course, one should keep in mind that an endless variety of options exists for urban planners, private developers, corporate decision-makers and municipal policy-makers in terms of economic specialization, transportation development, communication facilities and tendencies in location decisions. It follows that an endless variety of urban forms must also, therefore, exist. Although this decision tree model only identifies seven resulting morphologies, each with a very specific and seemingly linear path leading to it, caution should nonetheless be exercised. The purpose of this particular model is to provide a skeletal framework for a much more complex *non linear* system. Indeed, such a system would consist of an infinite number of possible outcomes, with each city being heavily influenced by a set of initial conditions which merely 'guided' it towards one of the seven proposed arrangements.

One can find several contemporary examples of cities that appear to fit this model. Detroit, for example, was heavily grounded in manufacturing throughout most of this century. A lack of anticipation of the decline of the manufacturing industry in North America led to the slow demise of Detroit's inner city economy. This encouraged the construction of radial highways out of the city, to points where more attractive sites for development were slowly attracting investment. A generally slow reaction to changing communication technologies, as well as a break-down of interpersonal communication links due to class and racial tension, have served to further fragment the community, resulting in decentralization of the city. If these events are traced through the model, one finds that the resulting predicted form is either "True Poly-nuclear Urbanization" or "Donut Urbanization", depending on one's classification of Detroit's current level of communication networking. Generally speaking, this is an accurate description of the scenario in Southeastern Michigan. While the Hartshorn and Muller (1989) and Erickson (1983) models were found to contain elements which questioned their applicability to the Detroit area, the generality of the "True Poly-nuclear Urbanization" and "Donut

Urbanization" categories allows the necessary latitude to permit inclusion. Of course, over-generalized classification is a weakness in any model, but models which demonstrate principles at a macro level are often necessary before detailed generalizations can be made.

Toronto, on the other hand, was able to anticipate the decline of the manufacturing sector in North America and redirect its attention towards the information producing "Office/Research" functions. Toronto's commitment to providing a compact public transit system as well as development of international personal and electronic networks has turned it into a compact, centralized city which serves as a major centre of national and international control. Again, applying these events and characteristics to the model, one finds that the resulting outcome for Toronto is predicted to be a "Global/Regional Hub City". Obviously, in the interest of simplicity, many of the categories in this model have been intentionally uncomplicated. A "Global/Regional Hub City" for example, gives little indication of the actual *physical* characteristics of the city, unlike "Donut Urbanization" which is much more descriptive. Such a "hub city" would not necessarily be without suburban concentrations of population, but instead would be characterized by a *relatively* centralized urban arrangement.

This model can be applied to many other North American cities. Los Angeles, with its network of highways and diversified economy, terminates at "Global/Regional Hub City", however, may exhibit signs of ' Urban Sprawl". Atlanta, on the other hand, has chosen to develop beltways and radials of transportation, while maintaining an up-to-date communications network. The application of the model to Atlanta identified it as a "City with Dependent Satellites".

When consideration is given to compromises between categories where decisions in the 'tree' are not quite as obvious (as in the example of Los Angeles), the possibilities of the application of this model are nearly endless. Perhaps the greatest obstacle to general acceptance of this model, and indeed, much of urban research today, is an inability to quantify aspects of cities which would allow proper evaluation and testing of growth models.

APPENDIX A

Detroit City Data

Detroit City	1950	1960	1970	1980	1990
Population	1,849,568	1,670,144	1,511,482	1,203,339	1,027,974
Managerial and Professional					
Executive, Administrative and Managerial	60,910	36,448	26,038	25,721	26,016
Professional Specialty Occupations	64,336	61,474	63,939	39,671	36,858
Technical, Sales and Adminstrative Support	173,319	148,077	141,023	117,364	105,214
Private Household Occupations	12,918	15,655	9,312	3,123	1,761
Protective Service Occupations		8,796	10,098	11,557	13,479
Service Occupations (other)	65,052	54,511	70,528	59,162	51,961
Farming, Forestry and Fishing	608	332	907	1,079	1,795
Precision Production and Repair	123,434	80,338	69,567	38,875	29,468
Operators, Fabricators and Labourers	249,165	166,962	169,772	98,115	68,940
TOTAL WORKFORCE	749,742	572,593	561,184	394,667	335,512
Managerial and Professional					
Executive, Administrative and Managerial	8.12%	6.37%	4.64%	6.52%	7.75%
Professional Specialty Occupations	8.58%	10.74%	11.39%	10.05%	10.99%
Technical, Sales and Adminstrative Support	23.12%	25.86%	25.13%	29.74%	31.36%
Service Occupations					
Private Household Occupations	1.72%	2.73%	1.66%	0.79%	0.52%
Protective Service Occupations	0.00%	1.54%	1.80%	2.93%	4.02%
Service Occupations (other)	8.68%	9.52%	12.57%	14.99%	15.49%
Farming, Forestry and Fishing	0.08%	0.06%	0.16%	0.27%	0.54%
Precision Production and Repair	16.46%	14.03%	12.40%	9.85%	8.78%
Operators, Fabricators and Labourers	33.23%	29.16%	30.25%	24.86%	20.55%

APPENDIX B

Southfield Data

Southfield	1960	1970	1980	1990
Population	31501	69285	75568	75728
Managerial and Professional				
Executive, Administrative and Managerial	1583	4665	6518	6355
Professional Specialty Occupations	1914	7229	8451	9616
Technical, Sales and Adminstrative Support	2865	8360	14467	14742
Private Household Occupations	150	152	76	66
Protective Service Occupations	74	137	272	298
Service Occupations (other)	598	1643	2569	2900
Farming, Forestry and Fishing	25	11	78	183
Precision Production and Repair	2033	2590	2987	2638
Operators, Fabricators and Labourers	1573	2794	2631	2927
TOTAL WORKFORCE	10815	27581	38049	39725
Managerial and Professional				
Executive, Administrative and Managerial	14.64%	16.91%	17.13%	16.00%
Professional Specialty Occupations	17.70%	26.21%	22.21%	24.21%
Technical, Sales and Adminstrative Support	26.49%	30.31%	38.02%	37.11%
Service Occupations				
Private Household Occupations	1.39%	0.55%	0.20%	0.17%
Protective Service Occupations	0.68%	0.50%	0.71%	0.75%
Service Occupations (other)	5.53%	5.96%	6.75%	7.30%
Farming, Forestry and Fishing	0.23%	0.04%	0.20%	0.46%
Precision Production and Repair	18.80%	9.39%	7.85%	6.64%
Operators, Fabricators and Labourers	14.54%	10.13%	6.91%	7.37%

APPENDIX C

Troy Data

Troy	1960	1970	1980	1990
Population	19058	39419	67102	72884
Managerial and Professional				
Executive, Administrative and Managerial	528	2001	6402	7961
Professional Specialty Occupations	874	4547	7029	9363
Technical, Sales and Adminstrative Support	1396	4125	8054	12984
Private Household Occupations	100	45	43	83
Protective Service Occupations	50	146	290	308
Service Occupations (other)	408	894	2486	2658
Farming, Forestry and Fishing	98	17	81	196
Precision Production and Repair	1331	2524	3329	3176
Operators, Fabricators and Labourers	1459	2246	2638	2563
TOTAL WORKFORCE	6244	16545	30352	39292
Managerial and Professional				
Executive, Administrative and Managerial	8.46%	12.09%	21.09%	20.26%
Professional Specialty Occupations	14.00%	27.48%	23.16%	23.83%
Technical, Sales and Adminstrative Support	22.36%	24.93%	26.54%	33.04%
Service Occupations				
Private Household Occupations	1.60%	0.27%	0.14%	0.21%
Protective Service Occupations	0.80%	0.88%	0.96%	0.78%
Service Occupations (other)	6.53%	5.40%	8.19%	6.76%
Farming, Forestry and Fishing	1.57%	0.10%	0.27%	0.50%
Precision Production and Repair	21.32%	15.26%	10.97%	8.08%
Operators, Fabricators and Labourers	23.37%	13.58%	8.69%	6.52%

APPENDIX D

Michigan and Auburn Hills Data

Michigan	1960	1970	1980	1990	Auburn Hills	1990
Population		8,875,068	9,262,078	9,295,297		17,076
Managerial and Professional						
Executive, Administrative and Managerial	150,645	218,131	344,094	461,176		1,440
Professional Specialty Occupations	246,636	348,471	458,961	566,936		1,331
Technical, Sales and Adminstrative Support	706,616	898,666	1,094,318	1,282,192		3,731
Private Household Occupations	44,666	31,727	17,278	12,991		0
Protective Service Occupations	31,905	41,389	55,535	66,395		141
Service Occupations (other)	262,450	337,252	450,043	492,272		1,018
Farming, Forestry and Fishing	60,202	62,043	62,585	65,443		66
Precision Production and Repair	509,918	517,189	493,802	501,629		884
Operators, Fabricators and Labourers	760,993	797,709	774,136	717,162		1,343
TOTAL WORKFORCE	2,774,308	3,252,577	3,750,732	4,166,196		9,954
Managerial and Professional						
Executive, Administrative and Managerial	5.43%	6.71%	9.17%	11.07%		14.47%
Professional Specialty Occupations	8.89%	10.71%	12.24%	13.61%		13.37%
Technical, Sales and Adminstrative Support	25.47%	27.63%	29.18%	30.78%		37.48%
Service Occupations						
Private Household Occupations	1.61%	0.98%	0.46%	0.31%		0.00%
Protective Service Occupations	1.15%	1.27%	1.48%	1.59%		1.42%
Service Occupations (other)	9.46%	10.37%	12.00%	11.82%		10.23%
Farming, Forestry and Fishing	2.17%	1.91%	1.67%	1.57%		0.66%
Precision Production and Repair	18.38%	15.90%	13.17%	12.04%		8.88%
Operators, Fabricators and Labourers	27.43%	24.53%	20.64%	17.21%		13.49%

BIBLIOGRAPHY

Berry, B. J. L. and Cohen, Y. S., (1973) 'Decentralization of commerce and industry', in L. H. Masotti and J. K. Hadden (eds) The Urbanization of the Suburbs, Sage Publications, Beverly Hills, California.

Birch, D. L., (1975), 'From suburb to urban place', Annals of the American Academy of Political and Social Science, 422, 25-35.

Brotchie, J., P. Hall and P. Newton (1987) 'The Transition to an Information Society' in The Spatial Impact of Technological Change, Croom Helm, London.

Burgess, E. (1925) 'The Growth of a City: An Introduction to a Research Project' in R. Park (ed) The City: Suggestions for the Investigation of Human Behaviour in the Urban Environment.

Button, K. and Rossera, F., (1990) 'Barriers to Communication', in Annals of Regional Science, 24, 337-357.

Clark, W. and P. Hosking (1986) Statistical Methods for Geographers, John Wiley & Sons, New York, New York.

Cohen, R. (1981) 'The New International Division of Labour, Multinational Corporations and Urban Hierarchy', in M. Dear and A.J. Scott (eds.) Urbanization and Urban Planning in Capitalist Society, Methuen, London.

Colby, C. C. (1933) 'Centrifugal and Centripetal Forces in Urban Geography', Annals of the Association of American Geographers, 23, 1.

Doxiadis, C. (1970) Emergence and Growth of an Urban Region: The Developing Urban Detroit Area, Volume 3: A concept for future development, Detroit Edison Company, Detroit, Michigan.

Erickson, R. (1983) 'The Evolution of the Suburban Space Economy', Urban Geography, 4, 95-121.

Funk, R. and Kowalski, J., (1987) 'Innovation and Urban Change', in J. Brotchie, P. Hall and P. Newton (eds.) The Spatial Impact of Technological Change, Croom Helm, London.

Gad, G. H. K. (1975) 'Toronto's central office comlex: growth, structure and linkages', Ph.D. dissertation, University of Toronto, Toronto.

Glickman, N. (1987) 'Cities and the International Division of Labour', in M. Smith and J. Feagan (eds.) The Capitalist City, Blackwell Ltd., Oxford, G.B..

Gordon, P., Richardson, H. and Wong, H. (1985) 'The distribution of population and employment in a polycentric city: the case of Los Angeles', Environment and Planning A, 18, 161-173.

Gotterman, J. (1977) 'Megalopolis and Antipolis: The Telephone and the Structure of the City', in I. de Sola (ed.) The Social Impact of the Telephone, MIT Press, Cambridge, Massachusetts.

Haig, R. (1926) 'Towards an Understanding of the Metropolis', Quarterly Journal of Economics, 40, 402-434.

Hall, P. (1990) The Disappearing City?, working paper 506, University of California at Berkeley.

Harris C. and E. Ullman (1945) 'The Nature of Cities', Annals of the American Academy of Political and Social Science, 242, 7-17.

Hartshorn, T. and P. Muller (1989) 'Suburban Downtowns and the Transformation of Metropolitan Atlanta's Business Landscape', Urban Geography 10, 375-395.

Harvey, D. (1989) The Urban Experience, John Hopkins, Baltimore, Maryland.

Heikkila, E., Gordon, P., Kim, J. I., Peiser, R. B., and Richardson, H. W. (1989) 'What happened tothe CBD-distance gradient?: Land values in a polycentric city', Environment and Planning A, 21, 221-232.

Heilbroner, R. (1962) The Making of Economic Society, Prentice-Hall, Inc., Englewood Cliffs, New Jersey.

Hepworth, M. E. (1987) 'The spatial division of information labour in Great Britain', Environment and Planning A, 19, 793-806.

Hill, R. and J. Feagin (1987) 'Detroit and Houston: Two Cities in the Global Perspective', in M. Smith and J. Feagin (eds.) The Capitalist City, Basin Blackwell, Oxford, U.K..

Hoyt, H., (1939), The Structure and Growth of Residential Neighborhoods in American Cities, U.S. Government Printing Office, Washington, D.C..

Huang, S. (1989) Office Suburbanization in Toronto: Fragmentation Workforce Composition and Labour Sheds, Ph.D. diss., University of Toronto.

Hymer, S. (1971) 'The Multinational Corporation and the Law of Uneven Development', in J. Bhagwati (ed.) Economics and World Order, Macmillan, New York, New York.

Jeppsen, P. (1984) Telecommunication--Transport Interaction--and Spatial Structure, ITTI workshop paper, Telematic, Stuttgart.

Kellerman, A. (1984), 'Telecommunications and the Geography of Metropolitan Areas', Progress in Human Geography, 8, 2.

Kerr, C. (1963) The Uses of the University, Harvard University Press, Cambridge Massachusetts.

Khan, A. (1976) 'Travel Versus Telecommunications: Current Understanding', High Speed Ground Transport, J, 10.

Kindleberger, C. P. (1978) 'U.S. Foreign Economic Policy', Foreign Affairs, 55, 395-417.

Lakshmanan, T. (1989) 'Infrastructure and Economic Transformation' in A. Anderson, D. Batten, B. Johansson and P. Nijkamp (eds.) Advances in Spatial Theory and Dynamics, North-Holland, Amsterdam.

Langdale, J. (1989), 'The Geography of International Business Telecommunications: The Role of Leased Networks', Annals of American Association of Geographers, 79, 4.

Ley, D. (1985) 'Downtown or the Suburbs? A Comparative Study of two Vancouver Head Offices', Canadian Geographer 29, 30-43.

Lorenz, E., (1979) "Predictability: Does the Flap of a Butterfly's Wings in Brazil Set Off a Tornado in Texas?" address at the annual meeting of the American Association for the Advancement of Science in Washington, December 29, 1979.

Mandeville, T. (1983), 'The Spatial Effects of Information Technology', Futures, 15, 65-72.

Massey, D. (1984) Spatial Divisions of Labour: Social Structures and the Geography of Production, Macmillan, London.

Matthew, M. (1993) The Suburbanization of Toronto Offices, Institute of Urban Studies, Winnipeg.

McDonald, J. F. and McMillen, D. P. (1989) 'Employment subcentres and land values in a polycentric urban area: the case of Chicago', Environment and Planning A, 22, 1561-1574.

Memmott, F. (1963) 'The Substitutability of Communications for Transportation', Traffic Engineering, 33.

Meier, R. (1985) 'Telecommunications and Urban Development' in J. Brotchie, P. Newton, P. Hall and P. Nijkamp (eds.) Technological Change and Urban Form, Croom Helm, London.

Metro Detroit Office Guide, (1991), Greater Detroit Chamber of Commerce.

Moss, M. (1987) 'Telecommunications and International Financial Centres' in J. Brotchie, P. Hall and P. Newton (eds.) The Spatial Impact of Technological Change, Croom Helm, London.

Muller, P. (1976) The Outer City: Geographical Consequences of the Urbanization of the Suburbs, American Association of Geographers Resource Paper No. 75-2.

Nelson, K. (1986) 'Labour demand, labour supply and the suburbanization of low-wage office work', in Scott, A. J., and Storper, M., (eds.) Production, Work, Territory: The Geographical Anatomy of Industrial Capitalism, Allen and Unwin, Boston, Massachusetts, 149-161.

Nijkamp, P. and Mouwen, A. (1987) 'Knowledge Centres, Information Diffusion and Regional Development' in J. Brotchie, P. Hall and P. Newton (eds.) The Spatial Impact of Technological Change, Croom Helm, London.

Oi CD, (1981), 'Information Activities, Electronics and Telecommunications Technologies', ICCP Series, No. 6, 1.

Parker, E. (1976) 'Social Implications of Computer/Telecom Systems', Telecommunication Policy, 1.

Perry, D. (1987), 'The Politics of Dependency in Deindustrializing America: The Case of Buffalo, New York', in M. Smith and J. Feagin (eds.) The Capitalist City, Basil Blackwell, Oxford, U.K..

Pisarski, A. (1987), Commuting in America: A National Report on Commuting Patterns and Trends, Eno Foundation for Transportation, Westport, Conneticut.

Porat, M. (1977) The Information Economy: Definition and Measurement, 77-12(1), Office of Telecommunications, U.S. Department of Commerce, Washington, D.C..

Pressman, N. (1985), 'Forces for Spatial Change', in J. Brotchie, P. Newton, P. Hall and P. Nijkamp (eds.) Technological Change and Urban Form, Croom Helm, London.

Richardson, H. (1972) The Economics of City Size, Lexington, Lexington.

Scott, A. (1986) 'Industrialization and Urbanization: A Geographical Agenda', Annals of the Association of American Geographers, 76(1), 25-37.

United States Census Bureau, (1950), Population and Housing Characteristics.

United States Census Bureau, (1960), Population and Housing Characteristics.

United States Census Bureau, (1970), Population and Housing Characteristics.

United States Census Bureau, (1980), Population and Housing Characteristics.

United States Census Bureau, (1990), Population and Housing Characteristics.

van Lierop, W. and Nijkamp, P. (1985) 'Modelling Urban Dynamics' in J. Brotchie, P. Newton, P. Hall and P. Nijkamp (eds.) Technological Change and Urban Form, Croom Helm, London.

Weber, M. (1963) 'The Urban Place and the Nonplace Urban Realm' in M. Webber Explorations Into Urban Structure, University of Pennsylvania Press, Philadelphia, 79-153.

Wheeler, J and Mitchelson, R. (1989) 'Information Flows Among Major Metropolitan Areas in the United States', Annals of American Association of Geographers, 79, 4.

Wigan, M. (1985) 'Transport-Communication Interactions' in J. Brotchie, P. Newton, P. Hall and P. Nijkamp (eds.) Technological Change and Urban Form, Croom Helm, London.

VITA AUCTORIS

Steve Bocska was born in Windsor, Ontario where he completed most of his academic training. He attended the University of Windsor for his Bachelor of Arts in Geography (Honours). His undergraduate thesis, entitled "Determining the Relative Touristic Attractiveness of Hotel and Motel Clusters in Windsor", was presented at the annual meeting of C.A.G.O.N. in 1991. More recently, he presented a preliminary draft of a non-linear model of urban growth to the annual C.A.G. meeting in 1993. His practical experiences in the field of urban planning include three consecutive summer assignments with the Downtown Business Assocaition as an analyst, a three-month temporary position at the Windsor Planning Department and a part-time assignment at the Windsor-Essex Development Commission collecting and analyzing land-use data. He is currently working in the Town of Kingsville in a contract position preparing a 50-year Economic Strategic Plan.